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Man and Environment

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Indian Society for Prehistoric and Quaternary Studies

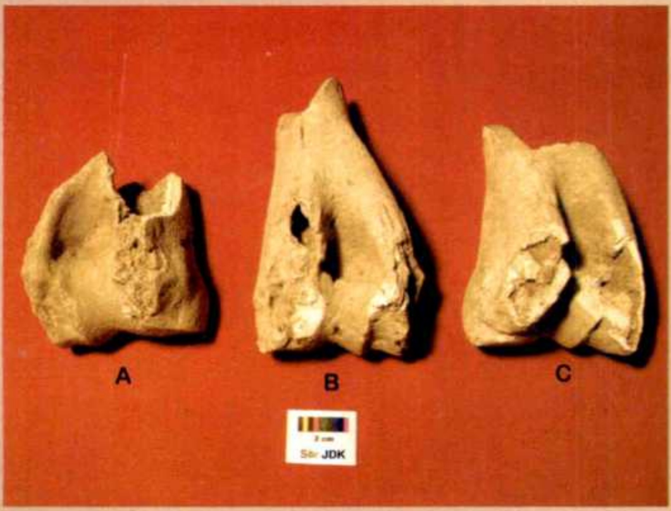

Fig. 4 Bones showing the gnawing marks

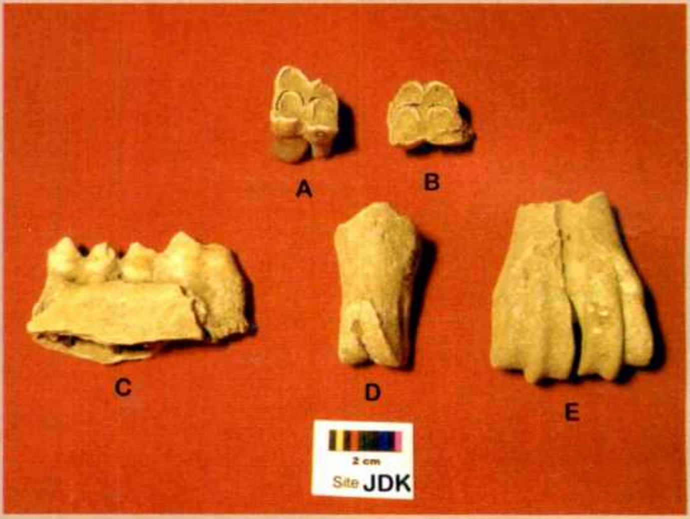

Fig. 8 Bones of nilgai

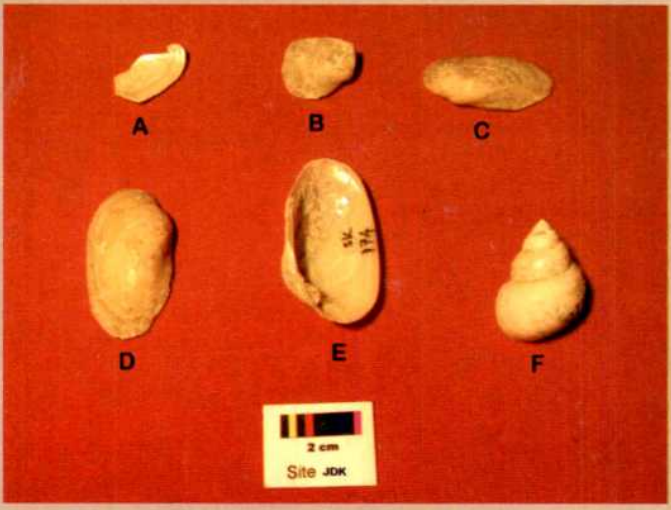

Fig. 13 Molluscan shells

Joglekar P.P., *et al.*, *Man and Environment* XXXV(1): 76-86 [2010]. © Indian Society for Prehistoric and Quaternary Studies

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Man and Environment

Journal of the Indian Society for Prehistoric and Quaternary Studies

Editor: V.N. Misra
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Editorial

As usual, this issue of the journal too has articles on topics spanning different cultural periods and subjects. To begin with, we have presidential addresses of S. Nagaraju and Vidula Jayaswal delivered at the Anural Conferences of the Society at Bhubaneshwar and Allahabad, respectively. S. Nagaraju demonstrates how archaeological studies are relevant to studies in history. Vidula Jayaswal gives a comprehensive picture of recent developments in archaeology of the Middle Ganga Valley.

Readers will find three articles related to survey methods and results. Shipton *et al.* discuss findings of their systematic transect surveys in the Jurreru valley in Andhra Pradesh. R.N. Singh *et al.* report preliminary results of their Rakhigarhi hinterland survey conducted in 2009. Findings of a surface reconnaissance and geologic provenance studies at Mitathal in Haryana are discussed by V.N. Prabhakar and his colleagues in the ASI, who conducted it.

There are three articles related to biological remains. Steven Weber *et al.* attempt to provide an explanation for agricultural diversity in the Indus Civilization. P.P. Joglekar and Pankaj Goyal describe the faunal material from Jaidak (Pithad), a Sorath Harappan Site in Gujarat, and Arati Deshpande-Mukherjee and her colleagues report on faunal remains from Mahurjhari in Maharashtra.

Anup Mishra and his colleagues of the AIHC& Archaeology Department of the M.J.P. Rohilkhand University, Bareilly were excavating the PGW site of Abhaipur in Pilibhit District of U.P. for some years. They report findings of a study of glass bangles from the site. Vibha Tripathi and Prabhakar Upadhyay have written on the findings of their investigations at Judwani in Sonbhadra District of U. P.

In ME XXXII (2), 2007 we had published a `Gazetteer of Pre- and Protohistoric Sites in Gujarat' by S.V. Rajesh and Ambika Patel of the M.S. University of Baroda. The authors inform us subsequent to publication of the authors discovered some serious errors in site names and references, for which they have expressed sincere regret. We are publishing their corrigenda in this issue. We trust that future authors will take every care to ensure that while preparing their manuscripts, especially of site gazetteers and review articles, credit due to previous workers is properly acknowledged. Failure to do so causes embarrassment to the authors as well as the journal.

We had printed colour photos with H.P. Ray's article in a previous issue. In this issue we are printing four colour photos, the cost of which has been met by the authors as the Society is not in a position to meet the cost of printing colour pictures. The authors wishing to avail of this facility should contact the editors along with the details like size, number and quality of pictures well in advance.

We are happy to announce that we are soon going to launch a new website. This Site will contain information on articles in Man and Environment as well as on the activities of the Society Readers are requested to provide suggestions for making the Site maximum user-friendly.

The publication of this Journal has been financially supported by the Indian Council of Historical Research (ICHR) and the Archaeological Survey of India (ASI). The responsibility for the facts stated, opinions expressed, or conclusions reached is entirely that of the contributors of the articles. The ICHR, ASI and the Indian Society for Prehistoric and Quaternary Studies accept no responsibility for them.

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The Society publishes its bi-annual Journal (June and December) *Man and Environment*. This journal publishes recent and *original* research in the field of South Asian archaeology, including related topics in environmental, anthropological and historical disciplines. The journal has five types of contributions: research articles, short notes, review articles, obituaries, and seminar and conference news. Books are welcome for reviews. The editors will send the book to suitable scholars to be reviewed. All articles submitted for publication are sent to referees. Authors will be asked to revise their manuscripts in the light of these comments. Acceptance of the manuscript will mainly depend on the opinion of the referees.

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Cover: A steatite seal from Mitathal

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Relevance of Archaeology for Studies in Recent History*

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Honourable Chairman of this session, learned scholars and students, ladies and gentlemen, let me first of all express my gratitude to the authorities of the Indian Society for Prehistoric and Quaternary Sciences for giving me this opportunity of presenting the Presidential Address for its 36th Conference being held in this historic city of Bhubaneswar. When the Executive Committee of the ISPQS asked me to accept this responsibility, I readily agreed as it is a great honour to receive from a prestigious academic body, and not easy to decline for ordinary persons like me. I presume that this offer is perhaps in recognition of my field work in prehistoric archaeology in the first ten years of my career, even though in the next four decades till today I have been continuously drifting into other fields of historical enquiry. Perhaps it could also be in recognition of the fact that in my writings the role of the disciplinary foundations of prehistoric archaeology has provided me a strong base for launching new lines of enquiry in the study of Art History, Social dynamics and other facets of the historical past, e.g. Nagaraju (1981) wherein the chronology and development of about 600 rock-cut monuments of the Early Historical Period have been systematically traced by using the methodological tools of prehistoric archeology. Nagaraju (1996) utilizes material remains for interpreting their socio-ideological background and traces the roots of the above social developments to the introduction of a new technology; and the consequent emergence of a neo-elite class in the region are traced in Nagaraju (1995).

For today's presentation I have chosen the topic, *Relevance of Archaeology for Studies in Recent History*. Even though the focus of ISPQS, as reflected in its journal *Man and Environment*, is on the study of the pre- and protohistoric past, I am inclined to lay an equal emphasis on the Quaternary. For both the archaeologist and the historian the very title may look funny, as this is in contradiction to the long held belief that the verbal sources of history provide more comprehensive information on historical facts than the dumb evidence of archaeology. However, a deep look into the histories as being written now discloses the inherent weakness of this belief, as most of the verbal sources are products of the dominant sections of the society and it is their perception that is coming to us as history. It could be hardly the total history of a region or nation or an era when a large section of the humanity and its concerns are kept out of purview in its coverage. It is in this context that the theoretical and methodological tools of archaeology, especially prehistoric archaeology, which deals more with mankind in general than any particular section of the society, that can provide us a meaningful understanding of recent history, sans the play of bias in historical reconstruction. The desideratum for this is a multi-pronged approach to understanding historical processes holistically. I would demonstrate later that this approach may prove to be a valuable contribution for development planning geared to solve many of the present day problems which are mostly the consequences of precedent historical happenings. Perhaps, illustrating this with an example would drive home the point better than simply making theoretical statements.

I would like to do this with reference to my recent studies on the causes of regional backwardness. My study area is primarily the so called Hyderabad-Karnataka region, (the Kannada speaking region which was part of the old Hyderabad State) comprising Bidar, Gulbarga, Raichur and Koppal districts in northern Karnataka.

Even to this day this region has remained as the most underdeveloped in the whole of Karnataka according to most investigators who have used several parameters to judge the level of quality of life. To be brief, I may cite one example, of the Gulbarga district. The Nanjundappa Committee Report on Regional Imbalances (2002) places nine out of its ten taluks under the 'Most Backward' category. According to the same report, out of the 24 taluks in the Hyderabad-

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* Presidential Address delivered during the 36th Annual Conference at Bhubaneswar (29-31, December 2008).

Karnataka region, 19 are "Most Backward", 2 are "Very Backward" and 2 others are "Backward". This is despite five decades of developmental activities undertaken in the region after formation of Karnataka in 1956. In the 1960's, when I had an occasion to tour round the region conducting a village-to-village survey of archaeological antiquities, the situation there was still worse, indeed. Briefly, to cite from one of my earlier writings (Nagaraju 2006), " The whole region was so barren that one could see miles and miles of plain land but not a single tree anywhere around. In the countryside, let alone any transport facility, there were no roads even, some dried up watercourses or narrow paths served as access routes. There was hardly any water body to speak of except for the rivers and a few deep wells here and there. In several places people trekking for miles to fetch drinking water was a common sight. Poverty, squalor and lack of any sense of public hygiene were staring at us everywhere in the villages".

But this is the very region that had supported human habitation from early Acheulian times onwards (Paddayya 1982). A large number of prehistoric and Early Historic sites had been reported in the region by earlier scholars and many more were noticed during my survey too (*List of Antiquities in Hyderabad State,* Hyderabad 1954; Nagaraju 1971). The region appears to have been an important province of the Mauryan Empire as can be made out from the large cluster of Asokan inscriptions found here and in the immediate neighbourhood. In the Hyderabad-Karnataka region, inscriptions of Asoka have been found at Sannati (Gulbarga District), Maski (Raichur District), and Gavimath and Palkigundu (Koppal District): other localities with Asokan inscriptions in the neighbourhood are Nittur and Udegolam (Bellary District), Brahmagiri, Siddapura and Jatinga Ramesvara (Chitradurga District) and Erragudi and Rajula Mandagiri (Kurnool District, Andhra Pradesh). There were several ancient townships like the famous Buddhist site, Sannati (Seshadri 1868). Despite the present day condition, I could notice during my survey remains of one or more beautiful temples in several villages, as well as hundreds of Prakrit and Kannada inscriptions in the region. It was also the centre of activity of two of the great royal dynasties, the Rashtrakuta and the Kalyana Chalukya, which played a significant role in politics for more than five centuries (8th-13th century C.E.). The Rashtrakuta capital was Malkhed (Gulbarga District). The capital of the Later Chalukyas was Kalyana (Bidar District). All these indicated a state of high prosperity enjoyed by this region once, in contrast to the present situation there. It is a historical enigma. But I had no explanation for this then.

But some political developments in Hyderabad-Karnataka area in recent years attracted my attention again towards that. Perhaps induced by the struggle for statehood in the neighbouring Telangana region of Andhra Pradesh, in Hyderabad-Karnataka too there was some political stirring for getting itself de-linked from Karnataka and to carve out a separate state. The reason stated was that in spite of the so called developmental programmes for the region supported by the Central and the State Governments for the last 40 odd years, there is no significant change and the region has continued to remain with its backward tag. To me, as an archaeologist/historian it was an interesting problem for investigation: while previously I was trying to tackle the question why a prosperous region fell into a state of backwardness, now another question was why a backward region remains backward despite developmental efforts? The puzzle became challenging, yet interesting.

The questions raised above require multiple tools of investigation. One thing however was clear, that this was not due to any environmental change caused by nature, as the neighbouring regions which enjoy a similar natural environment are much better off. However, the Marathwada and Telengana regions of erstwhile Hyderabad state have the same situation. The causes for transition of the region from the state of prosperity to that of backwardness have to be traced from the local historical happenings.

I shall try to provide here an explanation to the shift from prosperity to poverty that has happened in the region, extracting contemporary observational and past historical data, for the district of Gulbarga, though other districts of the region too share the same experience. Geographically the district is noted for vast expanses of treeless barren land, despite the fact that a major river, the Krishna, flows for nearly 100 km skirting the district in the south and another major river, the Bhima, fed by a number of smaller tributaries like the Amaraja, Bennetora, Mullamari and Kagina. The region also receives about 70 cm of average rainfall. With all this, peculiar phenomena like occurrence of flash floods and dry famine conditions simultaneously in the same region are common. Statistics of the district provide interesting data for understanding the ground situation (Table 1). Figures given in Tables 1 and 2 are from Govt. of Karnataka Annual Employment Report, Gulbarga District 2006-07.

Table 1: Gulbarga District – Land Resources

Total area	16,17,400 ha
Forest	67,931 ha
Barren and uncultivable area	63,155 ha
Cultivable area	14,86,314 ha
Irrigated area (canals)	77,406 ha
Irrigated area (tanks)	4200

Canal irrigation is a recent development, introduced after the completion of the Upper Krishna Project in the last decade. It covers a strip of land along the northern bank of the Krishna in Jewargi, Surapur and Yadgir taluks.

Agricultural statistics further inform us that though there is a vast area of cultivable land, nowhere (except in the strips of the canal irrigated region) is there a possibility of raising more than one crop a year and because of widespread semi-aridity and the vagaries of rainfall the crop yield is unpredictable. We may also note that the majority of suicide deaths of farmers are being reported from this district.

Besides, the population density of the region is also high, about 200 persons per km^2. The population of domestic animals (Table 2) in the district, which too depend on the same land resource, is also on the higher range.

Table 2: Gulbarga District – Dependents on Land Resources (2001 Census)

Human Population	31,30,922
Livestock	22, 17,908
Cattle	8,19,620
Buffalos	2,24,109
Sheep	4,59,515
Goats	5,62,104
Others	1,52,560

Thus the continuous pressure of human and animal population on the vegetation cover of the region has caused a general environmental degradation. For example, in this district (Table 1) we notice that the forest cover is just 4%. Further according to Champion and Seth (1968), the forests of the region come under Type 5/D5/SI: Southern Tropical Dry Deciduous Scrub, which is characterised by "... shrub growth, 3-6 m high, including some tree species reduced to similar conditions, usually many-stemmed from the base due to heavy human and cattle interference. Many of the shrubs are unpalatable to cattle (*Holarrhena, Dodonaea*) or thorny (*Randial Carrissa*). Thin grass occurs throughout. The stunted growth of trees is directly attributed to felling, grazing, lopping and frequent fires".

Many developmental agencies operating in the region for the last three decades have been trying to recognize the root cause of the problem. A document of one such agency, the Agricultural Finance Corporation (Mid-term Evaluation of Integrated Wasteland Development Programme, 2004) runs as follows:

"Deforestation and improper land use are the direct causes of recurring floods and drought in the country. The continuing degradation of tree-clad areas and consequent irreversible damage to ecology and environment have contributed to increased area under wastelands. Due to rapidly increasing human population, there is relentless pressure for the release of forest land for extension of cultivation, construction of irrigation projects, setting up industries, housing and human settlement and other requirements. Owing to over-exploitation, ruthless denudation of forests and uncontrolled grazing, land degradation has become more acute.

Extensive unproductive and under-productive lands are seen over a large part of the country. Most of these are included under wastelands. Besides, not being able to produce much needed fuel-wood and fodder, the denuded, eroded barren land has become a source of soil erosion with accompanying consequent ill-effects, accelerated run off resulting in less infiltration of moisture causing waster scarcity and poses a hazard to protecting, if not improving the environment.

Lack of vegetative cover on these lands even to the minimum extent to form a protective cover of soil in order to check erosion, leading to deterioration and degradation of the soil is resulting in colossal loss to the nation in general and to owners in particular. This is further accelerated due to uncertain rainfall which leads to periodic droughts with interspersed years of floods causing loss of property and crops, human and cattle lives, and above all of precious topsoil by water erosion. Apart from these calamities caused by nature and which are beyond control, the situation is further accentuated by man-made factors like unbridled deforestation, grazing and encroachment for habitation, industries, etc."'

It is with these contemporary observations that most of the so called development programmes undertaken in the last five decades have been planned, with hardly any success and the region continues to go with the backward tag. The cause for the failure of these development programmes actually lies in the fact that "It is a case of trying to treat a disease without proper diagnosis".

It was a surprise for me to find, hidden in my own notes on archaeological field work of the 1960's, a plausible answer to the question; why and when the process of the degeneration of land began. As stated earlier, I had noted the existence of a large number of temples and sculptures, as well as beautifully written Kannada inscriptions in almost every third village in the district. The region should have been quite prosperous once when these were created. During those field studies, when I visited a village called Nimbarga (Aland taluk) it was like any other in the region, struck with squalor. But in the very centre of the village there was a beautiful stone temple built in 1136 C.E. by a local chieftain serving under the Kalyana Chalukyas. It had a long foundation inscription too (Nagaraju 1971a). The writer of the inscription was so proud of this village that he praised it as a town resembling the very capital of Indra. What a contrast! Incidentally the inscription provided a description of the grandeur and beauty of the village stating that it was surrounded by extensive sweet smelling and sweet tasting rice and sugarcane fields, a number of tanks with lotuses growing in them, tender mango trees inhabited by parrots, a spread of cumin fields, flower gardens with scented flowers like jasmine, *champak* and *hadari,* large plantations growing banana, citrus fruits, date, coconut and areca. This was not just a piece of poetic imagination. The subsequent operative part of the inscription recording donations given to the newly constructed temple, names the gardens and wet lands growing some of the above crops, and also taxes levied on agricultural produce. None of these was to be seen anywhere around during my visit. If we carefully look through the above list of cultivated crops it becomes clear that many of them are those which require substantial and continuous water supply. One could deduce that the destruction of this facility could be the reason for the present aridity. In fact, in my fieldwork I had noticed the presence of a number of remains of irrigation tanks in almost every village, now completely silted up or in various stages of destruction or disrepair. The 12-13th century inscriptions seen in hundreds distributed in various villages often recorded the existence of one or more irrigation tanks around those villages. For example, a 1118 CE inscription from Handarki (Chitapur taluk) mentions six irrigation tanks, two ponds and a well situated around the village (Gogi 1996). So, this region might have developed an excellent water management system and this was the source of prosperity of the region in the past. One can also understand that in a monsoonal region like this - where annually the rainy season lasts just for 4-5 months with about 20-40 rainy days, followed by 7-8 months of dry season - the storing and management of short time fresh water precipitation to last for the whole year was most necessary for the survival of all life including human beings, animals and plants. Almost up to the end of the 13th century C.E., as can be seen from the inscriptions, there was continuous activity towards establishing and maintaining effective water management systems. The state and the royalty, various officers and merchants and many others who could afford were promoting such programmes. Various economic, technological and administrative strategies employed for this purpose were also being supported by suitable ideological and cultural systems. The construction of irrigation tanks, digging of wells or providing any water facility was being deemed as an act of merit (*punya-karya*). Thus a happy man-land relationship had been maintained with which both the land and the people prospered.

Archaeological investigations in the region show that from about the middle of the 14th century there was no more tank building activity and the writing of inscriptions in Kannada suddenly went out of vogue. This marks the end of the period of prosperity and the beginning of decline of the Gulbarga region leading to the present state of backwardness.

What happened may be briefly stated for record. This transition is directly associated with the shift in political control with the establishment of the Bahmani kingdom in Gulbarga in 1347 C.E. This new political authority headed and staffed by conquering warlords and soldiers, who mostly hailed from West

Asia or Delhi, had no idea of the local situation. They hardly needed it too, as the political philosophy, policies and programmes of the new rulers were those of dictatorial autocracy which was then in vogue in Europe and Western Asia. Following the administrative pattern of medieval states there, almost soon after the conquest, the whole kingdom was divided into *subhas, jagirs* or *iqtas* and given to the charge of top state functionaries and military officers. They were supposed to be the king's representatives looking after the administration of their provinces. Their only responsibility was to keep an army in readiness and render military service whenever called upon by the king, and pay a fixed sum of annual tribute to him. Within their territory they had unbridled authority to rule. In the Medieval political system there was no concept of welfare state or the state having any responsibility to the people. With the programme of tax farming adopted to accumulate as much wealth as possible, as the contemporary records show, the local inhabitants began to become poorer and poorer. They could neither participate in the administration nor had any say in their own local affairs (that is why Kannada inscriptions cease to appear from this time onwards). Their only job was to pay taxes to the *jagirdars* and to the state. Thus in this new setup all local institutions like the village assemblies ceased to function. Age old administrative mechanisms built for the construction and maintenance of tanks fell into disarray, with the rulers having no interest or understanding and the local people having no say or means to manage them. Left to themselves, natural processes took charge. The tanks began to be silted up losing their water holding capacity gradually with many ultimately becoming defunct. The figures for irrigated area under tanks in Table 1 are revealing. The total area irrigated by tanks in the district is just 4230 hectares. There are about 326 tanks in the district according to a report of the Irrigation Department. This means that the irrigating capacity of a tank is just 19 hectares (Gulbarga District Gazetteer 1966).

The neglect of tank irrigation and the consequent drop in agricultural yield triggered a chain reaction. A new situation of biospheric imbalance was created. Groves and trees around the villages and natural forests were the first targets for fuel and fodder needs of the local population and the livestock, ultimately creating a treeless landscape. Gradually the process did not spare even small bushes resulting in the denudation of all green cover exposing vast tracts of land to soil erosion and creation of desert like conditions. The process is still going on.

Whereas in the neighbouring regions there were some constructive ameliorating programmes undertaken by the more enlightened administration of the Adilshahi's in the west and the Vijayanagara in the south, it was the misfortune of this region that it continued to he governed successively by rulers who continued with the same old despotic administrative system of the Dark Ages with no concern for people's welfare.. Here lies the cause of Hyderabad-Karnataka's backwardness, i.e. six centuries neglect of land and water management, from the time of establishment of the Bahmani rule in 1347 till the amalgamation of the Hyderabad State in the Indian Union in 1948.

Though the above inference relating to the causes of Hyderabad-Karnataka's present backwardness looks acceptable at the outset, logically speaking it still remains at the level of a hypothesis. From the point of view of currently used historical methodology, the whole exercise may look odd and indefensible as there is no mention of any supporting data from contemporary historical sources. For scientists, at best it could be at the level of a theoretical possibility but requiring demonstrable proof. Though more than a hundred Persian chronicles pertaining to this region and period are available, most of them are court chronicles concentrating on the life and achievements of the kings and the political elite. The life of the populace is of no importance for them. Glancing through tomes of political and economic histories of medieval Deccan, which have been reconstructed mostly on the basis of the above chronicles, I could hardly find any reference to the life of the populace, except one sentence in the travelogue of Athanesius Nikitin, a Russian merchant, who visited Bidar in 1470 C.E.

It is archaeology and archaeology alone which can provide any authentic data for the reconstruction of the total history of even the recent past. Many deserted village sites are available for investigation. There is vast scope for the archaeologist to work upon various areas like the urban-rural divide in economy and life styles, environment, technology and social change and so on. The theoretical frame work and methodological tools developed in prehistoric archaeology, could be highly useful in recovering field data and subjecting them to unbiased interpretation. With this the discipline of history itself could get enriched in an unprecedented way. In this direction the highly professional expertise available among the ISPQS membership consisting specialists from various branches of physical, earth and biological sciences would be a great asset. Take for example the case of the above discussed story of Hyderabad-Karnataka. It is straight away connected with man and environment relationship which happens to be the focal theme of enquiry in ISPQS, as reflected in the name of its official journal *Man and Environment.* What best we have been able to reconstruct above is just an outline of the course of events. But we have little information on the process which is going on for the last six centuries. The factors involved here in causing environmental de-generalization are primarily the geomorphological changes and changes in the biotic system, both falling under the major fields of investigation among the scientists involved in prehistoric and protohistoric studies. Adopting the same sharp methodological tools it is possible to provide a comprehensive indisputable account of the process of environmental degeneration from the medieval period to the present day. Perhaps, besides geomorphological studies, conducting controlled excavations in the silted tank beds or obtaining cores of sedimentary deposits through boring at different places, and analyzing the embedded wood, charcoal, pollen and other organic remains a successive history of vegetation can be built up for a span a thousand years or even more. Here is an unique opportunity for tracing the environmental history and the changing patterns of man-environment interface from a very early period to the present. This would give us a fund of information for the reconstruction of social and economic history of the region, - a source material almost unknown to the historians so far. In this connection, I feel glad to draw your attention to a pioneering study in this direction conducted some years back in the environs of Hampi (Vijayanagara) by Morrison (2008). In the course of her studies in pre-colonial archaeology she became interested in the process of agricultural intensification and how the nature of agricultural activities changed in the environs of the capital city of Vijayanagara. She has provided us an interesting account of a sequence of changing patterns in cultivated crops and natural vegetation there through an analysis of charcoal and pollen found in successive silt deposits in the Kamalapuram and Daroji tanks. With this she could add a new line of enquiry for understanding various factors connected with the process of Vijayanagara urban growth.

Perhaps here is a life time work open for a generation of ISPQS scientists, the field of history is looking forward for their help in adding a new dimension to the discipline. I may add in this context that the contribution of the scientific studies of ISPQS in this direction could be a highly valuable input for national development too. While mentioning above the continued backwardness of Hyderabad-Karnataka despite five decades of developmental activities, I remarked that it is a case of prescribing remedy without proper diagnosis of the disease. The crux of the problem lies here. How the process of degeneration of land in the region has not been properly understood so far can be seen from a report of the Karnataka Forest Department, which mentions the poor shrub forest and expansive treeless land and also states that it is not known whether there were trees earlier in this region. Another document speaks of the need for afforestation programmes in the region and suggests raising economically beneficial plantations of *Eucalyptus* and *Casurina,* which was later contested by environmentalists that it may lead to further degeneration of land. Can the ISPQS membership help the planners in identifying the nature of vegetation cover that was once there during the prosperous days of the region and whether they can be re-introduced? Perhaps this simple input may provide a logical basis for scientific planning for further development programmes. Such studies may become a regular pre-requisite for wasteland development programmes all over India. ISPQS can also become proud of contributing meaningfully to national development.

I welcome the august body of ISPQS to initiate such studies in the Hyderabad-Karnataka region. Thank you.

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Status of Archaeology of the Middle Ganga Valley: Stone and Early Iron Age Cultures*

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The twin compositions of the alluvial stretch of the river Ganga, and the adjoining hilly tracts of Vindhya-Kaimur range, form the nucleus region, where growth of technologies governing the economies of the prehistoric and early historic periods on one hand, and spirituality and ideologies of the highest order were attained, in later times, Archaeological discoveries during the last half-a-century, have given us an almost complete chrono-cultural sequence of prehistoric and early historic times. This has been the basis for the reconstruction of the early history of this region, as well as of the subcontinent. The contribution of Allahabad and Banaras Hindu Universities, in bringing to light the progress of human endeavour in this region, is well known. New information is being added continuously by these and other institutions to the available quantum of data. In the last decade, in particular, a number of new dates and material finds have been acquired. These dates pertain to technological innovations like the use of iron and the beginning of paddy cultivation. Besides, innovations of other techno-cultural traits like 'microliths' and 'neoliths' also are testified in this region. As a result, a haphazard and unconnected picture of the emergence technologies and their contribution to cultures is often seen in the reporting of these findings. Some terminologies appear to be losing ground, adding further to confusion. A number of us have been aware of this situation (Singh 2005). I have also raised some of these issues in other forums (Jayaswal 2009b). I deemed it useful to utilize the opportunity extended to me by my election by the Executive Committee of the Indian Society for Prehistoric and Quaternary Studies as its President for the 37th session for placing before the learned audience and readers some of these issues for the attention of archaeologists and historians.

The primary focus of this paper is to evaluate the prehistoric cultures of the Vindhya-Ganga region. But this canvas automatically gets expanded in space, when the data is viewed in terms of a pan India context. Such an exercise is necessary for drawing meaningful inferences even for regional studies. Lately, my field studies in the Varanasi region, have also enlarged the time bracket beyond the Stone Age. Accordingly, the theme of this paper includes issues related to the antiquity of iron and its impact on early iron using cultures, as well.

South and east Uttar Pradesh and south Bihar, an integral part of Middle Ganga Valley, retain rich records of archaeological as well as geomorphological information of early part of Quaternary period. It is, therefore, not surprising that the history of archaeological discoveries in this region goes back to the nineteenth century, when archaeological field studies were initiated in various parts of the Indian subcontinent. The discovery of Stone Age artefacts by J. Cockburn (1886), is an illustrative example, which brought the region on the prehistoric map. Subsequent findings brought to light a complete sequence of prehistoric cultures. Similarly, being the nucleus region for the growth of state and society of the early historical times, city sites like Kausambi (Sharma 1960 and 1969), Varanasi (Narain and Roy 1976) etc., were also excavated in the 1960's and 1970's.. The lower horizons of these urban settlements were subsequently found to have a wide scatter in the form of village sites. Diverse cultural groups showing a hierarchy of village and city on the one hand; and on the other the resource and consumer settlements, are found concentrated in both the alluvial plain and foothills. Instead of enumerating the details of archaeological remains, which would of course be difficult to do in the form a paper, I propose to mention significant findings of each of the major stages of early history individually, along with such enquiries which need debate and explanation.

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Palaeolithic Stage: Significant Discoveries and Less Known Aspects

It is satisfying to note that the full sequence of Stone Age Cultures woven within the context of the Pleistocene and early Holocene geochronology is the contribution of the middle Ganga Valley to Indian prehistory. Prehistoric remains found until the middle of the twentieth century throughout the country, were unable to bring forth a holistic sequence of Stone Age, — Palaeolithic to Neolithic. Nor could a distinct geochronology of Stone Age stages be ascertained. The Upper Palaeolithic was not distinct, and thus not recognized. Accordingly, it was officially accepted in 1961 and resolved that the set of Palaeolithic and Mesolithic terminologies prevalent in Europe and elsewhere be replaced by an African set of terms, — Early Stone Age (Lower Palaeolithic), Middle Stone Age (Middle Palaeolihtic) and Late Stone Age (Mesolithic) (Misra 1962). Recognition of the Upper Palaeolithic in the Belan Valley (Uttar Pradesh) in the seventies was of immense significance. G.R. Sharma and his team were successful in reconstructing a holistic techno-cultural sequence of Pleistocene and early Holocene periods in the Belan Valley. It is well known that from three successive gravel deposits, artefacts of all the three phases of the Palaeolithic were obtained. Gravel III, in association with Upper Palaeolithic tools, was the missing horizon which was brought to light, and accepted (Sharma 1973). Overlying this was a deposit containing remains of the Mesolithic. Besides, the identification of technological stages, palaeoclimatic sequence was also reconstructed in the Belan Valley on the basis of sediment studies (Sharma 1973 and Pant 1982). Absolute dates for prehistoric deposits, particularly those of the Middle and Upper Palaeolithic stages in the Belan, were important additions to Indian prehistory (Agrawal and Kusumgar 1974). Even though prehistoric investigations carried out in the Belan Valley followed the pattern of the river valley studies, their results were far reaching. For instance, although the river valley surveys, piloted on a large scale by the Deccan College, Pune, and adopted by other institutions, brought to light quite a large number of sites all over the country, the sequence of sediments was simplified and the format of human endeavour truncated (Sankalia 1962). The discoveries, therefore, were hardly sufficient for the reconstruction of the life of prehistoric man and contemporary climates.

The attempt to interpret the sediments of the Belan Valley by a number of scientists was yet another significant step in Palaeolithic studies in India. More than one interpretation of Quaternary climatic conditions was proposed for this region. For instance, G.R. Sharma (1973), in accordance with the generally accepted climatic cycles of tropical regions, correlated the gravels and silts, respectively, with wet and dry phases. Dassarma and Biswas (1976) attributed the deposition of Gravel I to the process of solifluction, a typical feature of frozen conditions. This team also believed the silt formations to be loessic in nature, and therefore suggested that the Belan region experienced periglacial conditions during the Pleistocene. P.C. Pant, rejecting this interpretation, argued in favour of the earlier hypotheses, with certain modifications (Pant 1982: 22-28). Gravel I according to him was deposited during a dry period, and the overlying mottled clay was a lacustrine deposit suggestive of water logging in wet conditions. He further suggested that there was a gradual increase in aridity as indicated by Gravel II and the yellow silt. His conclusion that the windy dry conditions of the time of formation of the yellow silt were responsible for the formation of rock-shelters in the Vindhyas is significant. A short wet spell prevailed in the region, when gravel III was formed. Incidentally this was the time (around 18, 000 BP), when a global shift from the Pleistocene to the Holocene occurred (Jayaswal 1990).

The possibility for the prevalence of cold conditions in Peninsular India as suggested by Dassarma and Biswas for the Belan, was also suggested by others for the southern parts of the subcontinent (Deraniyagala 1958: 32-33), and needs to be ascertained by fresh palaeoclimatic studies. For instance, recent field studies in Africa and a number of regions of the subcontinent have revealed existence of glaciation, along with short duration wet phases during the late Pleistocene and early Holocene times (Butzer 1974). This pattern somewhat corresponds with the proposed scheme of climatic cycles by Dassarma and Biswas (1976), who also date the entire sediment sequence of the Belan to between the late Pleistocene and early Holocene. At the foot of the Vindhyan Hills, tool manufacturing sites were identified near raw material resources (Pant 1982). These Lower, Middle and Upper Palaeolithic workshop sites, formed a separate category and could be correlated with the contemporary remains associated with the sediments of the Belan Valley. Except for some Upper Palaeolithic rock-shelter sites, like Laharia-dih (Pant 1982; Jayaswal 1983) habitation floors could not be traced in this region.

The location and exposure of habitation floors of the Acheulian times, at Paisra, in the Kharagpur range of Chotanagpur plateau, Bihar (Pant and Jayaswal 1991) was one such discovery which gave new meaning to Palaeolithic research. It was a lone example in India, and a very valuable addition to our knowledge of the Palaeolithic. The field data of Paisra is not only meticulously recorded, but the evidence has been extensively interpreted through application of various ethnographic models. The evidence unearthed at Paisra is unique in more than one way. It has revealed a large series of diverse types of shelters, in combination with post-holes and stone alignments. Examples of construction of temporary shelters with the help of plant components are numerous in the area; these are supported by stone alignments or wooden posts. These shelters could be reconstructed through ethnographic models of the local hunter-gatherers in India. Besides, the choice of the dwelling places and the camp-base and resource base strategies could also be demarcated at this site. It was clear from archaeological remains of the Paisra Valley that this region was a favourite resort of late/advanced Acheulian nomadic groups. This is because the valley had sufficient food supply, particularly during the rainy and post-rainy seasons. The areas around the present tribal village were repeatedly inhabited by small groups of food collectors. Not only were the dwelling locales carefully selected and located on the flat and higher places of the valley, but protective devices were also constructed to facilitate living. A complete format of day-to-day activities of early Stone Age man could also be reconstructed by determining various activity spots, which are grouped under camp-base and resource-base activities. The refuse resulting from both categories was distinct, forming varying archaeological patterns. For example, the sporadic scatter of artefacts, which were found almost in the entire Paisra Valley, in about a radius of 10 sq km, could be determined as food and raw material collecting zone. The dense concentration of artefact-scatters along with the remains of shelters clustering around the village of Paisra, could be recognized as a camp-base zone. The camp-base zone besides retaining evidence for shelters or the resting areas, also had such spots where tools were fabricated and food processed. Moreover, Acheulian dwelling behaviour of this valley, could also be ascertained in relation to palaeoclimatic data.

The palaeoclimatic assessment of Paisra Valley by Pant and Rana, suggests that it experienced arid conditions with some wet phase intervals during Pleistocene and early Holocene periods (Pant and Rana 1991: 101-105). Though there was paucity of floral and faunal remains, sediment studies helped in estimating Pleistocene climates. For instance the Acheulian appears to be coeval with the formation of a thin (10–35 cm) deposit of haematite pellets, which retained artefacts and traces of habitation floors. This was a comparatively humid time when the valley was covered with forest and edible flora and fauna. This heamatite deposit rested over the basal shale bed rock. The successive arid conditions in the valley were indicated by a thick yellow earth deposit, when Stone Age man left the region. At least two dwelling patterns in the valley appear to be governed by contemporary climatic conditions. One was the selection of higher parts of the valley as resting places, where habitation floors are located, and the other was the construction of temporary shelters by the inhabitants. It may be mentioned that although the Paisra Valley was a suitable habitat during the rainy season, in view of plenty of edible plants and roots, yet micro-ecological factors like water logging and strong cold winds during the monsoon season, create uncomfortable conditions for the dwellers. Protection from these factors in wet conditions perhaps governed the choice of Acheulian dwellings in the Kharagpur Valley.

It was however, not possible to date the Acheulian habitation of Paisra by application of absolute scientific methods. But, recent dates associated with the Acheulian remains of the country gives an age bracket of 670–190/66 ka (Paddayya 2008: 773). Since on techno-typological considerations, the Paisra tool-kit is characterized by advanced Acheulian features, and as the general age bracket proposed for the Deccan is approximately 350 ka,, we assume the date for the Acheulian habitation of the Kharagpur range could be around 400,00 to 300,000 years ago.

Although archaeological records for human behaviour are available for the Acheulian, the same could not be retrieved for successive Palaeolithic phases. For example, although many sites were discovered and some also excavated, the picture of the Middle Palaeolithic in the central Ganga Valley in particular, and India in general, remains more or less vague. This is because most sites are either surface finds or river valley sites. In case of sites which may be identified as dwelling locales, like the rock-shelter site of Bhimbetka, the nature of collection is such that a clear-cut distinction between the Acheulian and the Middle Palaeolithic is difficult to make. The recent discovery of Middle Palaeolithic, at Kalpi, too is indistinct, as far as, the cultural-kit is concerned. The middle of this deposit (Event II) is dated to *circa* 45 + 9 ka (Tewari *et al.* 2002), which is a little earlier than the generally accepted chronology of 40,000–42,000 B.P, for the beginning of the Middle Palaeolithic stage of this subcontinent (Paddayya 2008: 773).

It is also important to ascertain the validity of the date bracket proposed for the Middle Palaeolithic of India, as it falls short of the chronology of Mousterian stage of the other parts of the world. For example, in Europe, some of the Upper Palaeolithic cultures date back to around 40,000 BP (Soffer and Gamble 1990: 9). The archaeological data suggests that, the Mousterian had a concentration in the western part of Europe, and as one moves east and south, towards Africa and Asia, its European character is taken over by the local techno-culture traits. It is perhaps, for this reason, when Mousterian stages:-cultural activity of the early part of the last glaciation (Wurm I and II), are accessed in our region, they are marked by quite a few negative cultural traits. I shall elaborate this point in detail.

The typical techno-cultural pattern of the Middle Palaeothic phase in India has not been scrutinized properly. This is in spite of the fact that large collections are available now. I would like to comment on the present status of the use of techno-typology in Indian prehistory. Lately, techno-typological methods for the study of Palaeolithic collections are discouraged. Accordingly less attention is paid by the field investigators to the nature of tool-kits. Therefore, reporting on prehistoric collections often lacks detailed scrutiny and scientific analyses. This is in spite of the fact that the main bulk of data obtained from Palaeolithic sites comprises stone artefacts. So far no other foolproof methodology has been developed which could replace the techno-typological classification of Palaeolithic collections. Every discipline has its own method of studying the basic data. Is it not a fact that the entire chrono-cultural sequence of proto-and-early historic archaeology is based on techno-typological characteristics of ceramics? As a method of scientific analyses the utility of typology is undisputed. It has many advantages, ¾ classifying collections into technological groups and cultures, placing tool-kits into chronological sequence, and ascertaining relative dating etc. Besides, subsistence activities of the Stone Age man (working capacity or utility of tools), the physical capacity of the maker can also be assessed by this method. Without applying this method mislabelling and interpretation of field data occurs. Examples of such instances are increasing in recent reporting of prehistoric remains. This of course does not mean that one should minimize the utility of other methods and interpretation strategies. The latter would certainly depend on techno-cultural traits and other research patterns, when reconstruction of dwelling patterns, adaptive capacity of the environment, culture interactions, etc, are attempted.

I would like to demonstrate the utility of typological studies by mentioning some features of Middle Palaeolithic tool-kits. In India, one finds that very finely made tools of the Mousterian tradition are scarce (Jayaswal 1978). Developed technologies and effective tools made on flakes detached in various forms after preparation of cores have been identified as the technological attainment of the *Homo neanderthalensis,* the species which is known to have an almost equal cranial capacity to modern man. Instead, the Indian Middle Palaeolithic appears to be a tradition in which the tendency to make serrated edges and notches on the working edges of the tool was dominant. A case study of techno-typological features of Indian collections indicates that Middle Palaeolithic collections have very dominant proportions of denticulated and notched flakes and scrapers, which is comparable to the Mousterian of Denticulate tradition of Western Europe (Pant and Jayawal 1978). Similarly, there is strikingly low proportion or even absence of pointed tools and points made on triangular flakes or Levallois and Mousterian points (Jayaswal 1978). However, one does find some borers in the collection with short working edges prepared by alternate retouching. The questions, which need to be attended to, on priority basis, therefore, are two fold. Firstly, finding and identifying the author/authors of the Middle Palaeolithic culture/cultures of India. Secondly, determining the possible mode of subsistence and day to day activities of this man. The search for primary context sites of the Middle Palaeolithic phase too is important.

In the Upper Palaeolithic phase, although recognized with certainty, collections brought to light are limited and mostly characterized by non-specific tools. A poor technological attainment during this period is also reflected by the collections, specially when compared with findings in Europe. An explanation should be sought for the low proportion and less well developed blade technology and the tools made on these can hardly be accepted as classical types. It may be held that the studies of the Upper Palaeolithic phase in India are still far from satisfactory. For, not only are the find very limited, their nature and context of habitation deposits are poorly represented. The non-specific nature and tendency for notching and denticulation of edges of tools, continue from the earlier phase to this stage also. Instead of flakes, tools are now made on blades and bladelets. As a result, the conspicuous absence of well made blade tools, like knives, pointed tools, burins, etc. is glaring.

The other noticeable feature is that the bladelets/ micro-blades and microliths -the diagnostic technology of Mesolithic - form an integral part of most of the Upper Palaeolithic collections of our region (Pant 1982; Sharma and Clark 1983). Undoubtedly, their occurrence is much lower in count than in the Mesolithic period, yet their presence is significant in view of the hypothesis that microlthic technology was an adaptive innovation to the Holocene climate. If we compare the recently proposed date bracket, — *circa* 25, 000 – 18, 000 BP, — ascertained by C_{14} dates for the Upper Palaeolithic remains of India (Paddayya 2008: 773), this time frame too lags behind the expected date bracket. Besides, one also finds low to almost negligible proportions of well made blades in the collections. The question one faces in this case also revolves around the physical capacity of man of the end of the Pleistocene in this subcontinent. The possible relationship of adaptation to ecology, vis-à-vis technological attainments, of the early *Homo sapiens* of India too is to be assessed.

The scrutiny of global climatic data around 18,000 B P. has shown that "in the southern hemisphere, environmental selection on behaviour is regarded as a powerful and dynamic explanation for changes in the archaeological records" (Gamble and Soffer 1990). The recent dating of the occurrence of microliths in very early contexts, *circa* 35,000 – 30,000 BP (Clarkson *et al.* 2009: 343), is significant to note. If microliths are accepted as an effort towards the adaptation of arid conditions of the beginning of Holocene, which they appear to be, is it not possible that their occurrence in the Upper Palaeolithic tool-bearing deposits evidence the tendency to adapt to new changes in environmental conditions during the Terminal Pleistocene? Also, was the early development of microlithic technology in India fulfilling the lacuna caused by non-development of blade technology? This would also suggest an overlap between the effectiveness of Middle Palaeolithic tool-kits and the microliths. The major issue to be debated now is whether the blade based technology and subsistence of the Upper Palaeolithic phase was ever established in a true sense, in the subcontinent.

I would like to sum up with the remark, that Palaeolithic studies in India have a history which is only a little more than thirty years younger than that in Europe. Since then, there has been continuous growth of this branch of study. It is heartening to note that at par with the other parts of the world in our region too, the progress of Palaeolithic studies shows ascending curve. Now we have reached a stage which confronts us with a number of challenging and interesting questions. But, not many of us are interested in this branch now. This situation is particularly alarming in the Ganga Valley, where many young archaeologists are trained in various research institutions and Universities. However, a negligible proportion of students undertake Palaeolithic studies. To my understanding this situation has arisen primarily, due to the indifference of experts in teaching and training the young scholars in the field. I would like to make a plea, that before it is too late, such specialized branches of archaeology, like Palaeolithic studies, should be supported and encouraged by individuals and institutions.

The Origin and Late Survival of Microlithic Technology: Vis-à-vis the Mesolithic

The early discoveries of microliths or "Pigmy tools", which have been identified as the diagnostic techno-typological trait of the Mesolithic, go back to as early as the middle of the nineteenth century, after the finds made by A.C. Carlleyle (Smiths 1906). Since then, due to continuous discoveries of microlithic sites not only have the collections grown richer the day, but, occupation of varying geo-ecological zones has come to light:- rock-shelters, river valleys, open area plateaus, horse-shoe-lakes, etc. A number of these have also been excavated. As a result it is possible to reconstruct Mesolithic life in a comparatively better way than earlier phases. In spite of this, 'Mesolithic stage' is the most misinterpreted phase in Indian prehistory. It is therefore, required to recall the major characteristics of this hunting gathering stage. Similar to the Palaeolithic (the remains of Pleistocene human activities), the Mesolithic is the shortest span of the Stone Age at the very beginning of the Holocene period. Efforts of man to adjust with changed climatic conditions, flora and fauna, is the inherent pattern of this cultural phase. It is true that the change from the Pleistocene to Holocene climatic conditions is now dated to around 18,000 BP (Soffer and Gamble 1990), yet, the date for the boundary between the two has not changed. Thus, the dividing line between the Pleistocene and Holocene periods is still accepted as 10,000 BP. Like the beginning, it is also essential to ascertain the end of the Mesolithic. The problem in this case is that we have late to very late occurrences of microliths in dated contexts. The question is that whether continuation of a technology, or technology based subsistence justifies use of the same term, when the main stream of culture had moved much ahead? For instance, is it logical to address remains of isolated pockets of microlithic as 'Mesolithic', when other contemporary communities were cultivating cereals and some of these were even using metal for various activities of their subsistence. Do we address incipient farmers of tribal communities of today, as 'Neolithic communities'? I shall return to this issue a little later. Here it is sufficient to mention that microlithic technology may be identified as the diagnostic character of Mesolithic, but it is not synonymous with the Mesolithic.

The true nature of Mesolithic of India was recognized in the middle Ganga Valley, when the horse-shoe-lake sites were discovered and their details were published (Sharma *et al.* 1980). Before this finding, the occurrence of microliths almost through out the sub-continent, barring some regional pockets, Himalyan region, and some parts of the coastal area, were classified under the 'Late Stone Age'. These were microlithic collections, but, were essentially not remains of the Mesolithic period. The discovery of camp-sites on the sides of the horse-shoe-lakes, thus, helped recognizing archaeological features of the Mesolithic phase in India. Besides revealing subsistence and dwelling tendencies of hunting-gathering communities, these findings dated to the early Holocene, around the ninth and eighth millennium B.C., (Sharma *et al.* 1980). The subsequent exposure of a Mesolithic habitation floor, in the Paisra Valley, Bihar, suggested that open plateau regions were also found suitable for habitation by hunter-gatherers of the eighth millennium B.C. (Pant and Jayaswal 1991). Exploitation of river banks of the tributaries of the rivers Ganga, Son and Belan during the early Holocene times too are well documented at sites like Baghor (Sharma and Clark 1983), and Chopani-Mando (Sharma *et al.* 1980). Occupation of rock-shelters in the Vindhyas was an earlier practice, which continued during the Mesolithic, and also in later times, as is revealed by the sites of Laharia-dih (Jayaswal 1983).

Though microliths may be identified as the diagnostic trait of the Mesolithic stage, their occurrence is not restricted to the Mesolithic period only. It has a long history, in which the Mesolithic is a significant section. I have identified eight different culture contexts in which these pigmy tools occur. These are, the Upper Palaeolithic, the 'Epi-Palaeolithic', the Early Mesolithic, the Late Mesolithic, the Neolithic, the Chalcolithic, the early Iron Age, and the isolated post-Mesolithic occurrences, termed by me as 'Microlithic Culture' (Jayaswal 1997: 37). These stages for general discussions may be divided into four major techno-culture categories, the pre-Mesolithic, the Mesolithic, the post-Mesolithic, and, the Microlithic Culture. Needless to mention that the contribution of each stage is significant. The process of formulation, prevalence and technological status of microliths, in a geochronological sequence is discussed below (Jayaswal 1997: 35-49).

The Innovative stage

The appearance and earliest existence of microliths in Uttar Pradesh is in association with the Upper Palaeolithic remains (Pant 1982: 101-102). The techno-typological attributes of the microliths, indicates that it was a modification and development of the blade technology. The beginning of microlith-making in the Belan and Son Valleys is dateable to *circa* twenty-fourth millennium B.C.. The archaeological remains from Gravel III of the Belan-

Seoti Valley and the later Pleistocene deposits of the Son Valley (Sharma and Clark. 1983) indicate that the Upper Palaeolithic industries which are dated by the radiocarbon method between 24,000 and 18,000 B.C., and are associated with microliths. The beginning of microlithic technology, as per the recent findings of Jawalapuram can perhaps be pushed back to around 35,000 B.C. (Clarkson *et al.* 2009). It is interesting to note that right from the beginning when pigmy tools formed only about 10% of the total implement collection, the microlithic technology appears in developed form in middle Ganga Valley, the specimens are made on well made bladelets (micro-blades having less than 12 mm width), and characterized by abruptly retouched side/sides, two morphological distinctions for identifications of a typical microlith. The forms of implements are mostly non-specific. For, the tool-kit is dominated by backed bladelets and presence of a few lunates. Such perfect geometric forms as triangle and trapeze are either absent or when present, they are in negligible proportions and of atypical form. It may, therefore be summarized that making of microliths emerged as a subordinate trait in association with blade based industries, during the terminal Pleistocene. It may further be held that the origin of this techno-culture trait was an innovation and not an invention or diffusion. This situation is well demonstrated in Uttar Pradesh, where it's earliest context has been unearthed (Jayaswal 1997: 38).

The Stage of dominance

The archaeological remains of the post-Pleistocene and the earlier part of the Holocene are dominated by microliths. This technocratic group not only appears to have formed diagnostic culture trait, but also seems to have multiple growth in the form of a variety of non-specific and specific implement types. The blade element and blade-based tools gave way to microliths and receded to the subordinate position. In archaeological reporting the remains of this stage are recorded as 'Epi-Palaeolithic', 'Early Mesolithic'and 'Advanced Mesolithic/Proto-Neolithic' (Sharma *et al.* 1980: 33-76).

The stone tool collection obtained from the succeeding stage, the Upper Palaeolithic, in Belan Valley has been identified by the investigators as 'Epi-Palaeolithic' (Sharma *et al.* 1980: 37). The term 'Epi-palaeolithic' is defined primarily for such cultures, in Europe, which though of early Holocene times, continue to exist with Palaeolithic technology; with the blade as the basic element. It may be mentioned that the collection of Phase I of Chopani-mando, shows features of the Mesolithic. Not only do microliths became very pronounced (up to 80% of the finished tools in collections), but, germs of semi-sedentism, of the Mesolithic kind, in the form of post-holes and the floors, have been noted in association. It may also be worthwhile to mention that the early divisions of microliths into three successive stages, non-geometric-aceramic; geometric-aceramic and geometric-ceramic, suggested earlier by Sharma, which still appear in some of publications, have completely lost ground, in the light of recent findings. The phase under consideration, may be identified as of non-specific and geometric forms of microliths, which is not associated with pottery.

The alluvial plains were suitable regions for the development of Mesolithic groups which were initially situated in the vicinity of hills. Evidence from Belan is a fine example. Gradually the alluvial ecozones lying away from the hills were also exploited. This inference is based on the wide distribution of Mesolithic sites in the middle Ganga plain. About two hundred sites have been located in Sultanpur, Pratapgarh and Varanasi districts (Sharma *et al.* 1980: 123-131). This suggests short duration occupation of the plains rich in food resources. The evidence unearthed at Sarai-Nahar-Rai, Damdama and Mahadaha clearly demonstrates that the shores of horse-shoe-lakes were the preferred habitats of hunter-gatherers who were attracted to the alluvial ecosystems. Savanah-type grass with patches of deciduous forests and small pools of water in the form of ponds and lakes, and small rivers were the geographical features which seem to have attracted Mesolithic populations in this region. The attraction of alluvial ecology was so strong that, even the scarcity of raw material was not felt as a serious drawback. It was overcome by long distance transport of raw material from the Vindhyan Hills. Besides, bone and antler were also used as substitute materials for stone. Though middle Ganga Valley was the most suitable habitat, alluvial tracts in the Son and Damodar Valleys were also occupied (Sharma and Clark 1983; Lal 1958). But the density of sites in Uttar Pradesh suggests that Mesolithic way of life continued here for a long period. The recently acquired third millennium B.C. date and cultivated species of paddy associated with burials at Mahadaha strongly support the possibility of the coexistence of hunting-gathering and food producing groups.

The subsistence of this time appears to have a strong tendency for hunting which is evident from the abundant faunal remains from excavated sites. The wild species of animals identified in the faunal assemblages include big as well as small animals and a good amount of aquatic creatures. The use of clay pots and heavy-duty tools suggest cereal consumption which, however, may not have been significant. But elements of semi-sedentism were strong as revealed by the remains of shelters. At Chopani-mando, seven huts were unearthed in Phase II. While at Sarai-Nahar-Rai post-holes and remains of floors indicate construction of temporary shelters (Sharma *et al.* 1980: 33-37 and 140). The size and location of hearths at Sarai-Nahar-Rai suggest community living and organized behaviour. The evidence for burying the dead in and around the settlement area was perhaps indication of patterned social behaviour.

On account of radiocarbon dates from Sarai-Nahar-Rai (8395 ± 110 B.C.) and Baghor II (6380 ± 220 B.C.), it may be held that between ninth and seventh millennia B.C. (Sharma *et al.* 1980; Sharma and Clark 1983), not only did the microliths acquire the status of formative theme, but this technological trait may be accepted as identification of the Mesolithic culture in archaeological record (Jayaswal 1997: 40). It may be emphasized that parallel to microliths, there is no other culture trait such as pottery or significant heavy-duty tool, which can be ascertained as an yardstick for recognizing this techno-economic stage. Soon after the microlith-dominated subsistence was well adapted in the alluvial ecosystem, food acquiring strategies began to emerge, and there began a shift from hunting-gathering to food production. New technologies like pottery and ground stone tool making also appeared which was a major breakthrough in the history of this region.

The post-Mesolithic occurrence of microliths falls within two categories, one which continued with the main line of techno-cultural progress, the other, which survived in isolation as the dominant culture trait. The earlier catergory has been identified by this author as, 'Stage of Survival', while the latter as, 'Stage of Conservatism'. Scrutiny of radiocarbon dates and the contemporary archaeological finds from various Microlithic, Neolithic and Chalcolithic sites of southern Uttar Pradesh and Madhya Pradesh indicates that it was around six millennium B.C., that the microlith using communities separated in two branches, as is suggested by the evidence from Adamgarh rock-shelter.

Stage of Continuity

Archaeological remains dating between sixth millennium B.C., and the early Christian era belongs to three technological stages, the Neolithic, the Chalcolithic and the early Iron Age. In this category, microliths continue to exist but acquire a subordinate status to the advanced technologies, which are diagnostic characteristics of the Neolithic, Chalcolithic and Iron Age cultures. In this case the chrono-progressive change in cultures is evident, but making of the pigmy tools of the earlier tradition persists in low to very low proportions.

Stage of Isolation

This branch depended primarily on microlithic technology and was a continuation of the Mesolithic way of subsistence. However, it post dates the Mesolithic, and continues parallel to the main stream of growth of other technology based subsistence of the successive periods, marking a separate and isolated branch. Since microliths are the most prominent culture trait of this group of culture make- up, it has been named by me as the 'Microlithic Culture'. The attitude to cling to the earlier technology in this case was very pronounced with a strong tendency of resistance towards change. This cultural conservatism is further marked by the tendency to be confined to the geographically isolated areas. Such regions, like the periphery of western deserts, Gujarat and Rajasthan, and hills of Vindhya-Kaimur, southern parts of Uttar Pradesh and Bihar (Jayaswal 1997: 43-45), were the select habitats.

Scrutiny of radiocarbon dates from the microlithic deposits of various rock-shelters of the region indicates that Microlithic Culture of the Vindhyan-Kaimur region survived for about five to six thousand years. The date from Adamgarh (5500 ± 130 B.C.) is noteworthy, as it is so far the earliest date for the Microlithic Culture. On account of this which sixth/fifth millennium B.C., may be ascertained as the beginning for the Microlithic Culture. Similarly, the dates obtained from Bhimbetka, help fixing the end of this age bracket to around 1500 B.C. (Jayaswal 1997: 45). Its late survival in restricted parts can be found up to the historical period, *circa* A.D. 1000 (date from Bhimbetka of (950 ±110 BP).

The Vindhyan Microlithic Cultures may be divided into two chrono-cultural stages. Its earlier stage appears to date between the sixth and the third millennium B.C. Marked by pastoralism and rice cultivation, the Neolithic subsistence seems to be an intrusion from the neighbourhood, the alluvial plain, where both domestication of fauna and flora were well established for some centuries. The later stage which post-dates 2500 B.C., is marked by borrowed elements of Chalcolithic and Iron Age cultures of the neighbouring fertile land.

In the early phase of Microlithic Culture, though hunting was practised, evidence for animal husbandry is also pronounced. The faunal remains from Bagor and Adamgarh sites suggest that both hunting and domestication of animals formed the basis for the subsistence of this culture. The ratio between the wild and domesticated animals from living refuse noted at Adamgarh is 1:1 (Joshi 1978:38). The identified species: one-humped cattle, buffalo, goat/sheep, etc., indicate mastering of herding for food resources. A nomadic tendency in which large rock-shelters were occupied as the centres of dwelling activities, was perhaps another noteworthy culture trait of the Vindhya-Kaimur Microlithic Culture. The thick habitation *debris* unearthed from the rock-shelters at Adamgarh (Joshi 1978) and Laharia-dih (Jayaswal 1983), supports this presumption, as undisrupted microlithic habitation deposits have been exposed at these sites. The tendency to occupy natural shelters and not to build huts for habitation was the tendency of the Microlith using communities occupying the hilly terrain.

The hunting gathering way of life aided by pastoralism persisted during the later phase of the Microlithic Culture also. Besides nomadism, which was essential for hunting-gathering, as well as the pastoral economy in the hills, short duration occupation of large rock-shelters also continued in the later phase. Microliths also remained the basic technological trait till the end. During the entire time-span geometric microliths along with the other unspecified forms survived as the main techno-cultural trait, which except for some frequency fluctuations remained more or less unaltered. Other culture traits such as heavy-duty tools may or may not be found. But, a limited number of pots are invariably associated with these finds. It may be mentioned that both hand-made and wheel-made pots have been retrieved from the habitations. The former appears to be the local production, while the latter was imported. The well fired and wheel turned pottery mirrors the techno-cultural levels identified as the Neolithic, Chalcolithic and Iron Ages of the neighbourhood. In the process of borrowing of pots, copper and iron implements, glass bangles and beads etc., were also obtained by the rock-shelter dwellers. It may therefore, be held that there was a close interaction in terms of exchange of goods between the authors of the Microlithic culture and other contemporary communities of the Ganga plain. In spite of the awareness of technological progress of the neighbourhood the microlith-using communities of the hills preferred to cling to the earlier way of living. I have identified this situation as a tribal character (Jayaswal 1997). It is not less significant that this feature of the periphery of the culture zone of the middle Ganga Valley is characterized by tribal tendency.

The above account clearly brings forth that close scrutiny of archaeological finds and dates is a fruitful excise if proper understanding of material expression of prehistoric societies is to be achieved. It is imperative to base cultural reconstructions on chronology and associated cultural traits. A scientific temper is needed not only for the study of Mesolithic and microlithic data, but also for the interpretation of later technologies and cultures.

Beginning and Expansion of Food Production Strategies

The initial discovery of a ground stone axe in 1842 was followed by a number of surface finds of stone celts in Chhota Nagpur plateau, northeast India and the Deccan. The excavations of Neolithic sites from 1944 onwards revealed a distribution of early pastoral and agricultural communities in various regions of the country (Thapar 1965, 1985). Each region has a different story to tell in respect of technology, subsistence and chronology. The evidence discovered in the alluvial plains adjacent to the Vindhyan foot hills in Mirzapur of southern Uttar Pradesh was unique (Sharma *et al.* 1980). The beginning of food production could be traced from the hunting-gathering stage here. The dated sequence of all the three stage, — hunting-gathering of the early Holocene, transition phase between hunting-gathering and food production, and fully developed food producing stage provides a text book sequence.

The twin geological compositions, the hills and the fertile alluvial plains, appear to be the most suitable ecological niche for this important transition stage. Besides suitable eco-systems this region also had an advantage of having successive stages of Stone Age cultures, which provided the desired cultural background. The culmination of hunting-gathering subsistence, for instance, was reached in the Mesolithic by six millennium B.C. in this region. The Late Mesolithic phase, which is also referred to as 'Proto-Neolithic', suggests transition between the hunting-gathering and the food producing economies. For example, some of the food processing equipment and the tendency of semi-sedentism, which were acquired during the Late Mesolithic phase marked the beginning of Neolithic. This evidence has been brought to light from Chopani-Mando. Archaeological remains of Koldihwa and Mahgarha, mark the later stage, when food producing subsistence had taken deep roots. Not only the lithic requirements for the tools could be fulfilled locally but, the alluvial plain and the forests provided domesticated varieties of plants and animals. The knowledge about the domesticated varieties of flora and fauna was already acquired by the end of the mature phase of the Mesolithic. It is therefore, logical to assume that the initiation and formulation of food producing stage in Belan Valley was completely in accordance with ecological factors and also adaptive qualities and technological skills acquired by the indigenous inhabitants of the Vindhya-Belan region.

Another important field investigation was conducted in the foothills of Kaimur, by the Banaras Hindu University. Evidence obtained by the excavations at Senuwar (Singh 2004), provided grounds for the reconstruction of the expansion of food producing practices to the east of the Belan Valley. The radiocarbon date (2200 B.C.) obtained from Period IA, at this site indicates that this wave of migration in the Kaimur region took place around the first half of the third millennium B.C.. As was mentioned above, in the Belan region, this stage was established for a number of millennia. It was the later group of the Vindhyan Neolithic which appears to expand eastwards following the zones of twin geographical compositions with which they were adapted. It is perhaps for this reason, that the regions, like Varanasi, which were away from the foot hills, were ignored during this process of migration. It may be held that the Varanasi region fell outside the boundary of early farming communities' habitat, since so far no trace of Neolithic occupation could be found in this region (Jayaswal 1997) the field data obtained in the present decade by the U.P. State Archaeology and the Allahabad University reveal a wide scatter of farming communities in the alluvial plain. This has widened the time span (8/7th to 3rd millennium B.C.) of this phase considerably (Tewari *et al.* 2008). The details of wild and cultivated species of cereals have been identified from the sites by the scientists of the Birbal Sahni Institute, Lucknow. The Middle Ganga Valley is perhaps the first region in India from which a large quantum of archaeological, botanical and geo-morphological data has been acquired. The question is whether all of this could be categorized under 'Neolithic'? Also, whether such a term as 'Early Farming', is a better alternative?

The first stage of food production in human history is termed 'Neolithic', world wide. The practice to increase the numerical quantity of edible plants and animals by artificial means was the new innovation of the Neolithic. The pastoral and farming practices of this early stage are characterized by incipient traits. However, growth in terms of domestication of single to multiple species, is another pronounced trend found in archaeological records of the Neolithic period (Jarrige 2009), as is the case in West Asia. It is also apparent that food production responded in a way that the entire culture format of the preceding hunting-gathering living pattern changed. Development of arts and crafts on one hand and organized sedentary dwellings on the other, appear to move fast towards urbanization, as is apparent in the archaeological records of the Neolithic of the West (Jarrige 2009). The remains of the middle Ganga Valley compare well in the antiquity of food production strategies, the other culture contents fall much behind the expectation. As the main characteristics of the incipient food production communities of our region like, the beginning of pastoral and farming practices, origin and development of potting technology, and growth of settlements, are still not distinct. In the archaeological records though the focus has been on the evidence of farming, nature and quantum of pastoral practice have not been paid much attention. Similarly, though early dates are available for food production, it is not certain if there is a pre-ceramic stage in continuation of which ceramic technology developed. Similarly, the dwelling tendencies of the agricultural communities of the region, are devoid of growth and marked changes for more than four thousand years and perhaps more of the Chalcolithic remains.

One of the main subsistence of Neolithic stage, animal husbandry, has chequerred history in middle the Ganga plain. The scrutiny of faunal remains from the 'Microlithic', 'Neolithic' and 'Early Farming' horizons of the Vindhya-Ganga region shows two chronologically and perhaps economically, distinct practices of animal domestication. These are confined to northern and southern parts of the Ganga plain. Though cultivation of rice in the northern part is of high antiquity (7th millennium B.C.), the practice of animal domestication (around 3000 B.C.) seems to lag behind. Period IA of Lauradewa clearly suggests that though grains were cultivated, this stage was associated only with wild mammal bones. It is only in the succeeding stage, Period IB, that domesticated goat appears along with barley and copper (Tewari *et al.* 2008: 363). In the light of the known history of food production this situation needs explanation. It may be recalled, for instance, that in the regions where origin of Neolithic is well documented, not only does the domestication of animals precede cereal cultivation, but sheep/goats are the first species to be domesticated by man. The antiquity of sheep/goat domestication in the southern part of the Ganga plain is much older than has been reported at Lauradewa.

The situation in the southern part of the Ganga plain is quite different. As domestication of animals and plants appear to have originated simultaneously, and also both domesticated species sheep/goat and cattle appear side by side right from the very beginning. The study of animal bones of Vindhya-Ganga region by A.R. Allur brings forth significant evidence of the existence of wild and domesticated species of cattle and sheep/goat (Allur 1980: 201-232). According to him physiographic changes are distinct in both these categories between the Upper Palaeolithic and Mesolithic, when only wild species were in existence. For example, *Bos indicus* and Ovidae/Capridae of the Gravel III appear in large and small sizes, while in Gravel IV, only smaller size of these species was retrieved. But the Mesolithic wild forms of cattle and goat/sheep were of large and medium sizes, as shown by the analyses of the osteological remains of Chopani-Mando, Sarai-Nahar-Rai and Mahadaha (Allur 1980: 206-211). Besides, the increase in the volume of the species and the quantity of bones also appear to expand considerably by Mesolithic times, indicating dependence on cattle and goat/sheep for food. This certainly would imply familiarity and also decrease in the count of these species in the natural habitat, during the Mesolithic, in comparison to earlier times. The Neolithic horizon of the Belan Valley is marked by very sizable collection of domesticated cattle (*Bos indicus*) and sheep/goat (Ovidae/Capridae). Though the wild varieties still continue, their presence is much reduced (6.5%). The physical distinction at this time in case of cattle was reduction of volume, while in case of sheep/goat instead of four breeds only two stable and solid breeds were identified. It may further be surmised that the animal domestication here was a local innovation with its roots in the earlier hunting-gathering subsistence. Also, around 6th millennium B.C., there appears to be branching of pastoral practice. In the alluvial plain, the cattle and goat/sheep breeding joined hands with farming practices. The contemporary non-agricultural communities of the hills, also adopted animal husbandry, with hunting-gathering livelihood. The reporting of bones of domesticated cattle and goat from Adamgarh with microliths is illustrative example of this situation.

Cattle and goat breeding in Vindhya-Ganga region formed part and parcel of pastoral economy without any demarcated line of succession. While, breeding of cattle with goat as a established practice may be dated to around 6th millennium B.C. as is evident from the date (5,500 B.C.) of Adamgarh rock-shelter, where equal proportions (1:1) of wild and domesticated species were recorded (Joshi1978: 38). In 3rd millennium B.C. its proportion reached 95% in alluvial sites, as recorded from Mahgarha (Sharma *et al.* 1980: 220). But the position of animal husbandry from beginning of Neolithic (7th millennium B.C.) and pre/proto-Neolithic levels is not clear. The beginning of animal husbandry in the region is shrouded in mystery. This is because information regarding the quantitative and morphological changes of the domesticated species from different levels of pre-, early, and late Neolithic horizons is not available. In case of Koldihwa-Mahagara, though changes of wild to domesticated species of cattle and sheep/goat have been mentioned, the chronological occurrence of these is not available (Allur 1980:220 ff).

History of farming in the middle Ganga Valley,

As per recent evidence it begins with rice cultivation in the 7th millennium B.C. (Tewari *et. al.* 2008). The ^{14}C dates of Koldihwa (Sharma 2008: 277) indicate its antiquity. An earlier date of 7477 B.C. at Jhusi, being an isolated example, awaits substantiation by more dates. It is logical to accept the dates falling within the seventh millennium B.C. for the beginning of Neolithic in the Ganga plain. It seems reasonable now as a number of dates from various sites are available (Pal 2008). Also, in the light of long hunting-gathering history in the Vindhya-Ganga region, an early date for rice cultivation at Koldihwa appears reasonable (Jayaswal 1997). The span of single crop cultivation, paddy, particularly recorded at Lahuradewa, persists for about two and half thousand of years (*circa* 5298-2900/2700 B.C.). Addition of other cereals like barley and wheat to cultivation is recorded at this site in the beginning of the fourth millennium B.C. In another instance, at the foot of the Kaimur Hills, at Rohtas, single crop cultivation of rice appears to continue till third millennium B.C. It is followed by multi crop raising, with the addition of barley and wheat. This scenario is also recorded in the palaeo-botanical record of Period IA, at Senuwar in Jharkhand (Singh 2004).

Appearance of earthen containers, one of the major categories of archaeological culture components, appears to be coeval with the food production stage in the Middle Ganga Valley. It may be recalled that, food production without pottery, aceramic stage, has been distinctively marked in the western part of this sub-continent (Jarrige 2008). But in spite of very early beginning of Neolithic in our region, this stage has not so far been reported to the best of my knowledge. The earlier findings of Vindhya-Ganga region, however suggest, beginning of pottery in late Mesolithic. In the sequence of microliths and pottery, it was placed with the geometric microliths, after two preceding stages, non-geometric and geometric. As the evidence stands today, it appears that the pottery with microliths appears to fall within the above proposed 'Microlithic culture', which certainly is later than the early stages of the Neolithic phase in the Vindhy-Ganga region. This aspect also needs clarification by further studies. Pottery of early phase, the Neolithic of the middle Ganga Valley, appears in a variety of fabrics, —Black-and-Red, grey, black and red wares, with distinct surface treatments such as slipping, cording, rusticating, and incising. Whether the two potting technologies, hand-modeled and wheel turned were mastered in succession is also not clear. Interestingly, the nature of ceramic collection remains unchanged for a long duration, with minor fluctuations in the proportion of one or the other ceramic types, up to the Early Iron age.

Occurrence of beads at sites, particularly of the northern belt of the , is another pronounced feature, associated with the multiple farming stage., Period IB, of Lauhuradewa (Tewari *et al.* 2008) which continues later in Saryaupar region (Singh 1994). The shelters constructed of wattle and daub represent semi-permanent dwellings. This is another feature of the farming communities of the Middle Ganga Valley, which continues for thousand of years, without much change.

^{14}C dates from all the farming and pastoral horizons of the Middle Ganga Valley fall within two distinct chrono-cultural groups. The early, —7th to 6th millennium B.C., which is marked by single crop cultivation and domestication of perhaps, single (?) and perhaps multiple species in quick succession. The later category which is dated to 4th-3rd millennia B.C. is marked by multiple crop raising, advanced form of farming. This group both in terms of chronology and the history of farming cannot be placed in true sense within 'Neolithic', as the incipient character in this case cannot be ascertained. At many sites, culmination of this stage can be seen in the use of metal, copper, without marked change in the general format of the culture. Evidence recorded at sites like, Koldihwa, Senuwar and Lauradewa is a demonstrative examples of this situation. Thus, there is need to separate this stage from the early Neolithic and assign it a proper nomenclature. Till a proper word is coined, I find 'Neolithic-chalcolithic', terminology, which was suggested by H.D. Sankalia in 1962 quite logical. My impression is that the Chalcolithic phase is also not distinct in our region. Since the Neolithic way of life with restricted occurrence of copper objects is the main format of the latter, the suggested nomenclature would be proper.

Another pattern which is emerging from the spread of farming practices and animal husbandry in the Middle Ganga Valley, is the regional pattern. The northern stretch of the alluvial plain, with the dividing line of the main course of the mighty Ganga, appears to be different than from that of south, — the alluvial plain adjacent to the foothills of the Vindhyan and Kaimur ranges. The north, lying away from the southern hills, did not have the advantage of lithic resources as south, which was suitable habitat of the earlier communities since very long. Thus, occurrence of domestication of plants and animals in the north appears to follow the model of dispersal from the western region. Contrary to which, the desirable background for the origin and growth of new subsistence strategies was available in the southern region, which may be explained through another model, — evolution and growth of cultures in a suitable ecological niche. However, in both the cases, the spread of the Neolithic subsistence practices was from west to east. These observations suggest, that it is high time that diverse patterns in the archaeological records be demarcated and their interpretation sought with the application of suitable models for demarcation of growth and expansion of techno-culture traits of early farming and pastoral communities of India in general and in particular.

Some observations on the early metal using communities in the light of recent findings in Varanasi

For around one-and-a-half decades, I have been conducting archaeological investigations in Varanasi region (Jayaswal 1998, 2009). I propose to discuss aspects of early metal using communities of the Varanasi region in particular and middle Ganga Valley in general. As was ascertained, earlier by the excavations of Kashi-Rajghat site, habitation history of this most holy and reputed nucleus of Indian culture started around the 9th century B.C. when iron was used in good proportions (Narain and Roy 1976). However, no Chalcolithic level was identified. In one of the recent publications it has been claimed that the earliest occupation of Sarai-Mohana, a satellite settlement of Kashi-Rajghat, was of the Chalcolithic period (Singh and Singh 2004). This identification, however, lacks proof. For instance, the excavators of Rajghat had identified the earlier occupation of this locality (Period IA), as 'pre-Northern Black Polished Ware phase', which at both the localities was said to be associated with iron. The report also states that both iron and copper were not found in Period IA of Sarain-Mohana. Then the question is as to why designate it as Chalcolithic? Besides, excavations conducted at many other sites in Varanasi region in recent years, have not revealed a distinct Chalcolithic level (Jayaswal 1998 and 2009; Jayaswal and Kumar. 2006). Excavations at Aktha, however, suggest that right from the very beginning iron was in use in the Kashi region. This has recently been dated to between 1750 and 1500 B.C. These dates are based on charcoal samples from the middle floor of Period I, in the excavations of Aktha during 2008 (Jayaswal 2009a). Throughout the thick deposit (3 m) of this period, iron is found in the form of small disintegrated pieces and some recognizable forms. One, it establishes the antiquity of iron in Varanasi region. Second it corroborates dates and interaction between resource area and consumer centres of iron of Kaimur-Ganga region.

Second millennium B.C. dates for occurrence of iron in Vindhya-Kaimur region have come from sites like Malhar and Raja-Nal-ka-Tila (Tewari *et al.* 2005). Plenty of iron slag is available in this region in natural form. These sites, particularly the latter, appears to produce a surplus quantity of iron objects, over the local demand of the settlement. On the other hand, growing sites located in the alluvial plain were more in need of iron articles. An example of this situation is revealed from the expansion of habitation in Period IB at Kashi-Rajghat (Singh 1985). The evidence for the early use of iron at Aktha connects the metal resource area with the consumer settlements. Besides the occurrence of iron, some of the other cultural remains of Period I of Aktha, such as hay-impressed roughly coated pottery, corded black-and-red ware, and black- slipped ware are marked by comparable features of the contemporary sites of the iron resource area.

Copper appears in the around the 3rd millennium B.C., within the Neolithic culture. But, the copper/ bronze or Chalcolithic stage in this region is very vague. There are a number of pre-NBP horizons in the , which provide a rich, but haphazard picture of the cultural remains. To mention a few, 'Chalcolithic Black-and-Red ware', 'copper using black-and-red ware', 'painted black-and-red ware in association with copper and/or iron,' etc. Interestingly, the culture of all these occurrences is marked by considerable uniformity.

Occurrence of some specific categories like the steatite beads in the northern region, form characteristic features of copper using communities. But, the most striking feature is a small to negligible proportion of copper and lithic objects associated with these deposits, for instance Narhan (Singh 1994), Agiyabir (Singh and Singh 2004), Senuwar (Singh 2004), etc. There is need to ascertain, whether there is a distinct Chalcolithic stage in the middle Ganga plain? If yes, then what were its main characteristics? And also, how are we going to term the cultures belonging to it.

There is a need to logically resolve the use of terminologies denoting cultures of the early metal using communities of the . The mindset believing in the unilinear growth of technologies tends to draw conclusions which are far from reality. Take for instance, labeling the pre-NBP horizon of Sarai-Mohana as 'Chalcolithic', when copper is absent in the collection (Singh and Singh 2004). Similarly, non-occurrence of stone, is argued strongly to replace the copper using stage in terms of a separate culture. "In the absence of any lithic component it is no longer appropriate to name this culture as Chalcolithic'. Hence we have designated this culture as 'Narhan Culture' (Singh 1996: 1, 1994). The question comes to one's mind, what is the criterion to name a culture? Also how much weightage is to be given to the absence or use of stone, when a region lies far from hills. Painted Black-and-red ware has been accepted as the diagnostic trait of Narhan Culture, which is said to be as high as 23% (Singh 1994: 50). But in later publications it is said to occur as 57.7% (Singh 1996). It is also a question for debate as to how much importance is to be given to paintings on pottery? For, many a time, in a single region two contemporary sites, close to each other, show presence (Kashi-Rajghat) and absence (Aktha) of paintings on pots. Could we separate the two collections as representing of different cultures? Further, high to very high percentages for a deluxe ware, like the Black-and-Red ware of Narhan Culture, is a unique situation. Deluxe wares of all kinds, are mostly in low to very low proportions in the ceramic collections of proto-and-historical times.

If we separate Middle Ganga Valley into two regions, north and south, the material remains of early metal using communities can be seen revealing regional patterns. Two factors appear to govern the diversity between northern and southern units. One, the proximity with the mineral rich area, the Kaimur-Vindhyan Hills in the case of the northern region, and secondly connectivity with the western region using copper mines of Rajasthan. The Saryupar plain, belongs to the latter. Contrary to this, sites of the south like Malhar and Raja-nal-ka-tila, were located in the iron resource belt, with none or very restricted accessibility to copper.

If we interpret the occurrence of iron in very early context, at least late contemporary of copper/bronze, the most logical explanation would be replacement of copper by iron in those regions where there was great scarcity of the former. It can be said that once metal (copper) was in use, the requirement of metal in those regions, where copper was unavailable, but iron was available in abundance, the only way to meet the requirement of metal was to use the natural resource of iron ores. Thus, extraction of iron from the ores of the Vindhya-Kaimur region was initiated early in the southern part of the middle Ganga plain. I understand on the basis of discussion with archaeometallurgists that the expertise needed for extracting metal from iron ore in a primitive way would be somewhat similar to taking out copper from the ore. In the southern region lying close to iron sources and very far from copper mines, the natural motivation was to exploit the iron ore. I also wonder if the use of the word '*Ayas*' in Vedic literature in two contexts, '*ayas*' first without the adjective '*loha*' and '*krishna*', and later in combination with two, —'*krishna-ayas*' and '*loha-ayas*' is also not a reflection of the situation just mentioned. These and other issues related to middle Ganga Valley need to be debated for resolution.

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Systematic Transect Survey of the Jurreru Valley, Kurnool District, Andhra Pradesh

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Abstract

Here we present the methods and findings of a systematic transect survey conducted in the Jurerru Valley, Kurnool District, Andhra Pradesh. Systematic protocols for locating, identifying and recording archaeological localities are detailed. The results of this transect survey are compared with those of a previous unsystematic survey to demonstrate some of the biases in the latter. The systematic data is then used to understand and compare landscape use during different periods of human occupation. The article demonstrates that systematic transect surveys can be used to examine landscapes of rich archaeological heritage.

Introduction

Since the mid-nineteenth century surveys have revealed an abundance of archaeological sites across India ranging from the Lower Palaeolithic to the historic era (Foote 1869; Clark and Sharma 1982; Pappu 1996; Chakrabarti 2001). Pedestrian survey has proven to be a productive and cost-effective way to identify archaeological localities (Paddayya 1982). Archaeological surveys conducted in conjunction with geological, geomorphological and palaeoenvironmental studies reveal how past populations adapted to habitats and landscapes (e.g. Pappu 1974, 1985). Landscape surveys have even been used to elucidate aspects of ancient cosmologies (Boivin 2004). However, on the whole, surveys undertaken in South Asia have been exploratory rather than systematic and may therefore bias locality distribution towards easily accessible locations, large sites, areas with high surface visibility, or particular classes of remains. In the absence of systematic data on the sizes and distributions of localities from different periods we are unable to draw firm conclusions about aspects of past behaviour such as settlement patterns and demography. Systematic transect surveys provide relatively unbiased data, so that the actual frequency and distribution of localities can be extrapolated from the survey sample (Burke and Smith 2004).

In the Jurreru Valley, Kurnool District, Andhra Pradesh (Fig. 1), key sites have been discovered, providing significant information on important topics ranging from the Neolithic of South India (Allchin, 1963); through the origins of microlith technology and modern human behaviours in South Asia (Clarkson *et al.* 2009); to the impact of the Toba supervolcano eruption, 74 kya, on hominin populations (Petraglia *et al.* 2007). However as no systematic survey of the region has been undertaken the local context of these localities is not well understood. To rectify this we carried out a systematic transect survey of the Jurreru Valley. The goal of the survey was to ascertain unbiased data on the frequency, size and distribution of localities in the Jurreru Valley, to interpret the landscape use of past populations.

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Geography

The Jurreru Valley drains part of the limestone, shale and quartzite uplands of the Cuddapah basin (Gupta *et al*. 2003). The valley flows north-eastwards in its upper reaches, arcing round to flow due east after the first 10 km (Fig. 2). It continues eastward for approximately 30 km, flowing out of the uplands and on to the plains (Fig. 2), where it then turns southeast for 15 km before emptying into a larger southward flowing Bhundu River. The study area for this survey was a 4.5 km stretch of the valley around the village of Jwalapuram, just before the river flows out on to the plains. At this point the valley floor is gently sloping and approximately 250 m above sea level. On the southern side of the valley are two parallel east-west oriented hills known as Eddulakonda, which comprise limestone and shale beds capped by intrusive dolerite dykes, reaching a maximum height of c. 350 m (Fig. 3). On the northern side of the Jurreru Valley is the steep limestone hill Peddakonda, which rises to a height of 480 m where it is capped by a quartzite plateau (Fig. 3). Large quartzite boulders that have detached from the plateau and litter the slope of Peddakonda, were used by humans as rock shelters (Fig. 4). Low limestone hills emanate eastwards from Peddakonda (Fig. 3). In the centre of the valley, at the western end of the survey area, is a steep sided shale hill called Kuppakonda (Fig. 3).

Survey Method

The Jurreru survey was conducted by three archaeologists (Ceri Shipton, Janardhan B., Jinu Koshy) and Hari Vishwanath, a local person from Jwalapuram trained in archaeological methods. The area chosen to survey was a 5.4 km stretch of the valley around the village of Jwalapuram in which a number previously known sites were located. The Jurreru Valley is aligned east-west in the survey area; in order to get a representative cross section of archaeological remains the surveyors walked transects at regular intervals north-south across the valley, from the quartzite plateau to the furthest dolerite dyke. The north-eastern most point of the survey was the Nawab Bungalow located on a small, limestone hill to the east

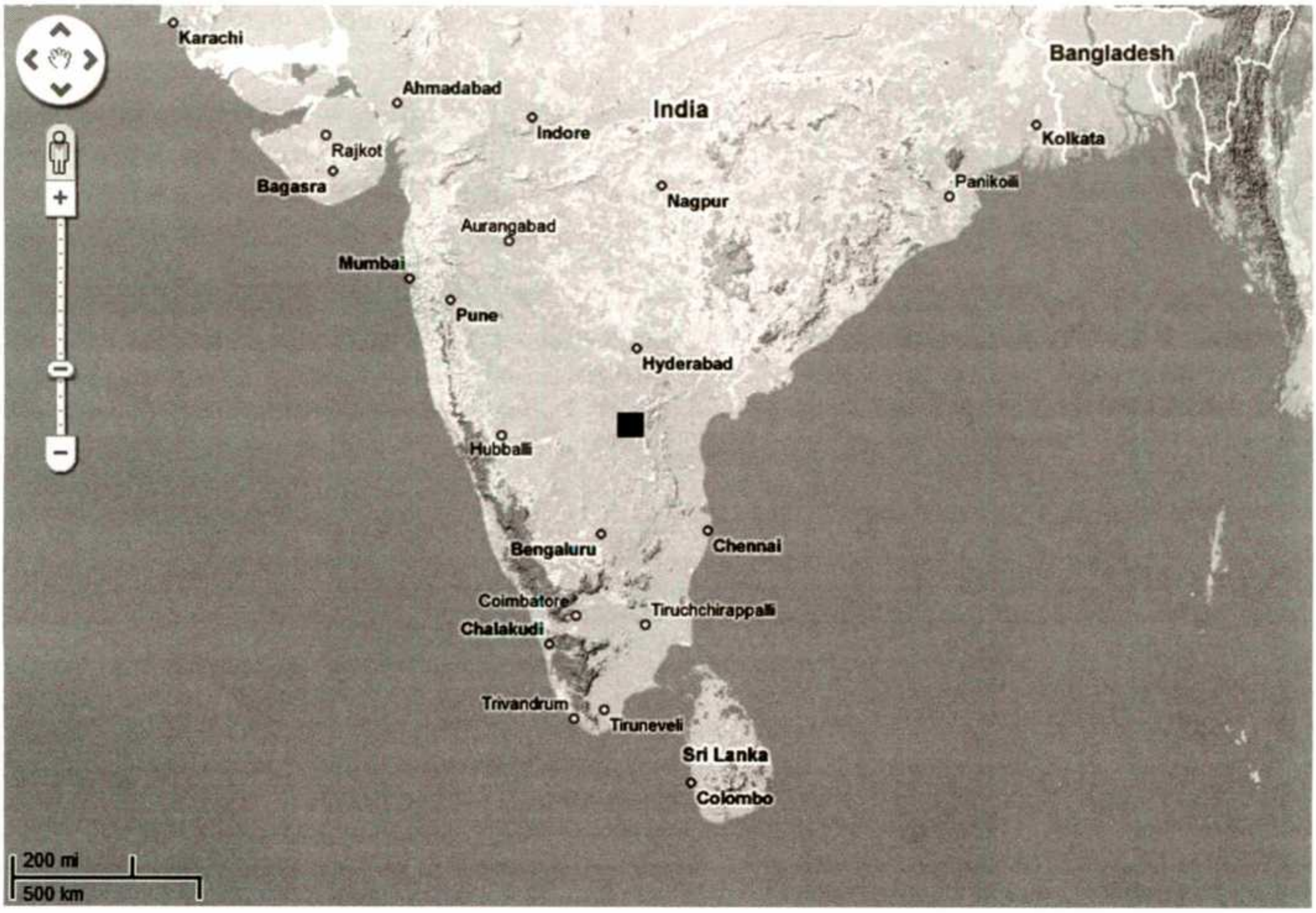

Fig. 1: Location of the Jurreru Valley, marked by the black square, in peninsular India

of the village of Patapadu, while the north-western most point was a break in the dolerite dyke where a road runs between the villages of Krishnagiri and Cherlakoturu (Fig. 3). Pedestrian transect surveys were conducted by walking straight lines across the study area, and scanning the ground for artefacts. As each person is effectively able to scan just over a metre either side of them, our four person transects were 10 m wide. Transects were spaced 200m apart, so they covered 5% of the total survey area (Fig. 5). Our survey was conducted over an area of approximately 13 km², 5% of which was covered by our transects.

Much of the Jurreru valley floor was covered by rice paddies and jowar fields that the surveyors were unable to cross directly, while the hill slopes were covered in thorn bushes which sometimes reached impassable density (Fig. 4). These obstacles precluded traditional transect survey methods of walking along tape lines aligned using a compass or landscape feature. The transects were, therefore, guided using a Global Positioning System (GPS) handheld unit, which negated the need to string out tapes and so saved the survey a great deal of time. Following a single latitude across the entire width of the valley using a GPS, as opposed to repeatedly using a compass, also meant the transects were straighter and therefore provided more systematic data.

Archaeological localities were identified on the basis of artefact concentrations, which were defined as a minimum of three artefacts within a 5m² area. Other types of archaeological localities were identified by the presence of rock art, structures, and/or human skeletal remains. For each locality we assigned a unique locality code consisting of a three letter abbreviation for the name of the nearest village followed by a number which was incremental (e.g. JWP 64). We noted the date the locality was found and recorded which transect, if any, the locality occurred on. We took latitude and longitude in the approximate centre of the locality as well as noting the approximate elevation using the GPS. Where there were artefact localities we estimated the density, which was divided into three categories, low (<1 per 2 m²), medium (>1 per 2 m² <1 per 1 m²), and

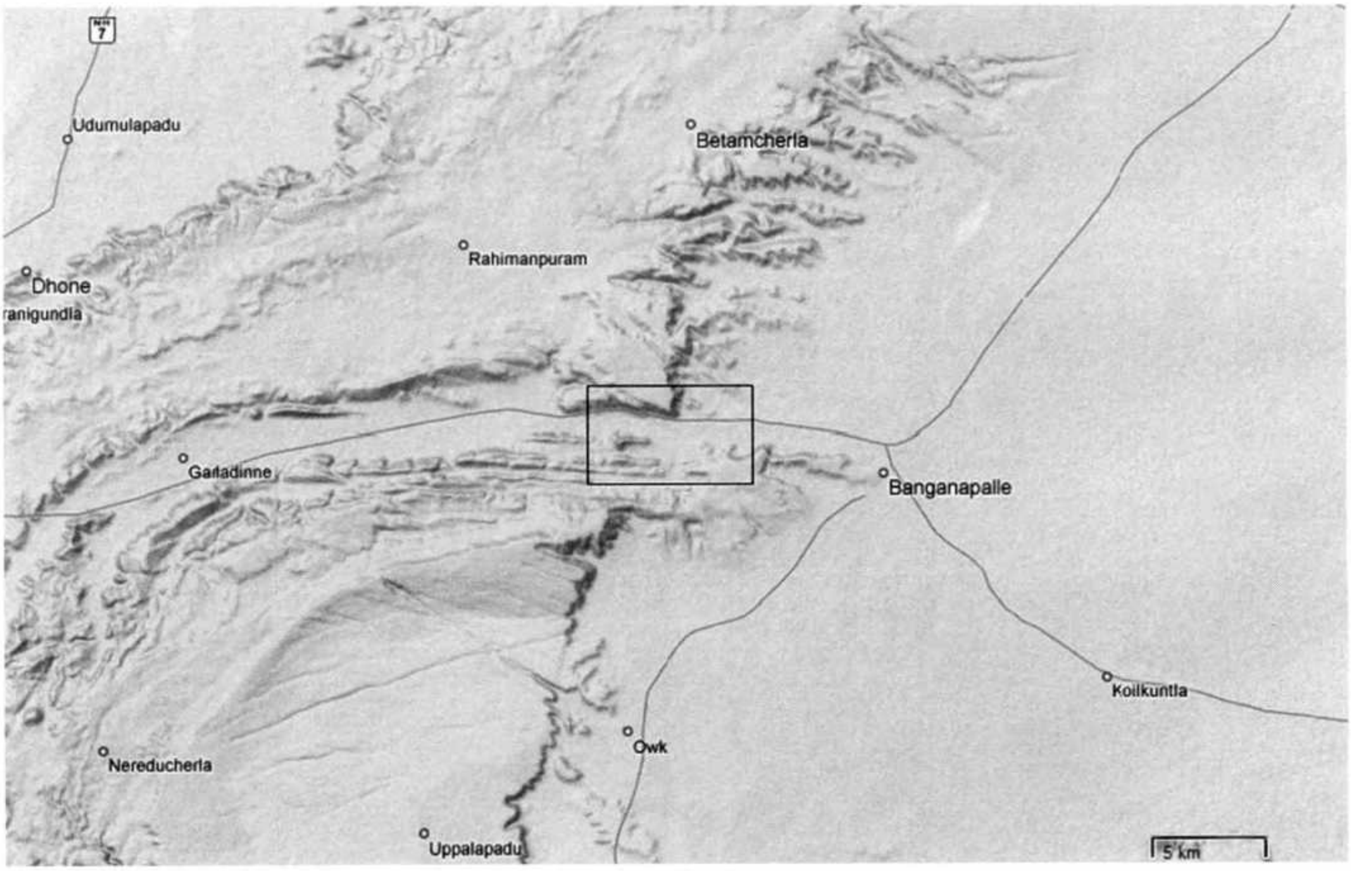

Fig. 2: The Jurreru Valley and surrounding terrain. The survey area is within the rectangle

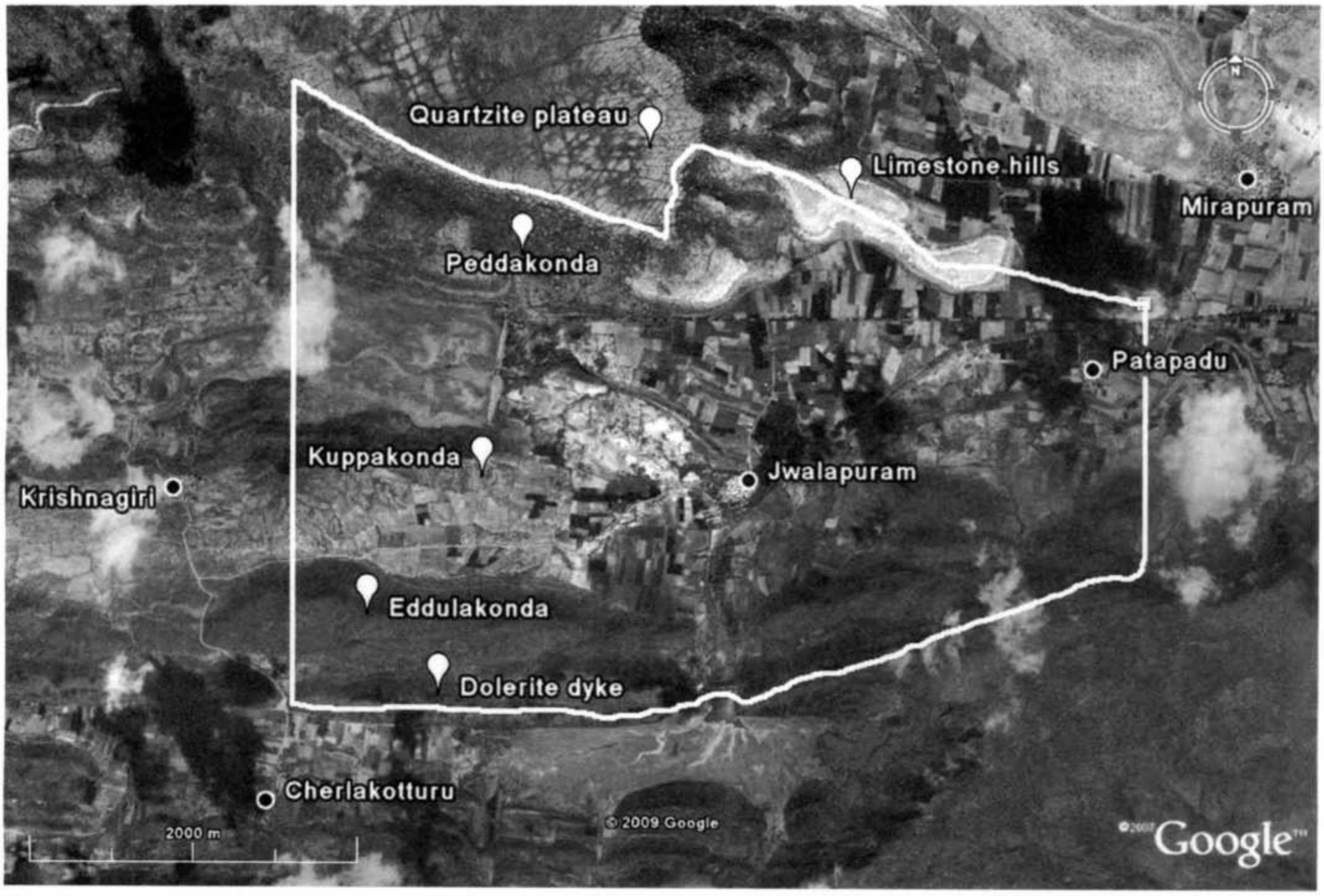

Fig. 3: Geography of the Jurreru Valley. Survey area outlined in white

high (>1 per 1 m^2). We estimated the approximate distance along the transect covered by the locality, to the nearest 5 m. We noted if the deposit at each locality appeared to be aggrading, eroding or stable. We described the surface vegetation, such as acacia scrub or grassland, and in the case of cultivated fields we noted the crop in question, as this greatly affects surface visibility. Based on the depositional and environmental context, the artefact density and the size of the locality, we also estimated the potential for finding artefacts in a buried context. Localities with a discrete, high density artefact scatter, which were uncultivated, with low vegetation cover, and had a stable land surface, were considered to have the best prospects for excavation. Each locality was photographed, and the direction and number of the photograph was documented.

Artefacts were not collected during the survey as this might bias future surface collection or result in the loss of localities altogether (Burke and Smith 2004). Instead the archaeological remains were described in the field with each category of remains having its own description criteria. In the case of lithics we recorded whether the artefacts were large, medium or small and noted the raw materials present. We recorded if the lithics included cores, flakes or retouched pieces and we noted and photographed any distinctive pieces such as blades, backed artefacts, or bifaces. For ceramics we described the colour and coarseness of all the wares present, whether there was any decoration and whether they were handmade or wheel made. For rock art we photographed and described the pictures noting any identifiable species represented and the colour of the paint. For structures we measured the dimensions, noted the materials it was made of and made an assessment of its possible function. For human skeletal remains we identified the bones and the minimum number of individuals represented. All survey data was recorded with pen and paper in the field, before being transferred to an Excel spreadsheet at the end of the week.

During the survey we encountered many localities as we were walking around obstacles blocking the transect trajectory, or while we were walking between

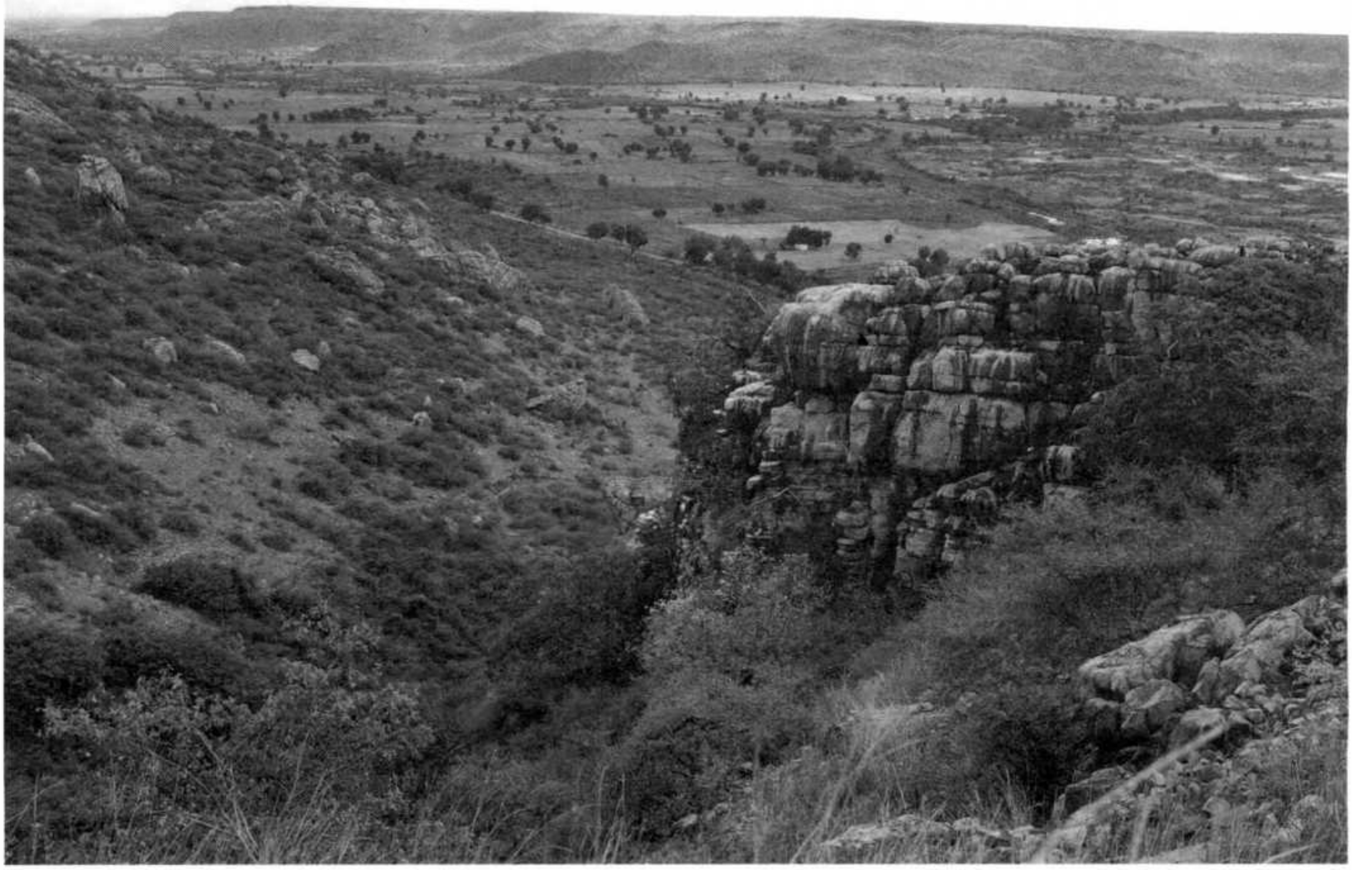

Fig. 4: View of the Jurreru Valley from Peddakonda looking eastwards towards Patapadu. Quartzite boulders that were sometimes used as rock shelters are visible on the left of the picture. Note that much of the valley floor is under cultivation and that thorny scrub covers the hillsides. The cave in which a Neolithic burial was discovered is situated in the cliff on the right of the picture.

transects. These localities were recorded as off-transect, allowing them to be analysed separately from the transect sites because they were not identified using the same systematic criteria.

Using diagnostic artefact types we were able to assign a provisional period to the majority of localities. The periods assigned by the survey are only intended as provisional guides as most surface archaeological remains are not dateable and may become associated for reasons other than their contemporaneity. Our survey was guided by excellent chronological information from previously excavated localities (Petraglia *et al.* 2007; Clarkson *et al.* 2009). The presence of Acheulean artefacts in the valley indicates human occupation extending as far back as the Middle Pleistocene. The Middle Palaeolithic in the valley is known to date from 78 to 38 thousand years ago, while the microlithic dates from 35 thousand years ago to the late Holocene. Neolithic localities were identified by the presence of Patapadu ware, coarse black ware, and hand-made red ware, ceramic styles that are known to date from the Neolithic (Fuller *et al.* 2007). The great majority of stone structures we encountered were megalithic burials, which emerge in this region at around 1400 B.C. and continue through the Iron Age and into the Early Historic period to circa 100 A.D. (Fuller *et al.* 2007). Localities lacking diagnostic artefacts or where multiple periods were represented were classed as unknown.

Comparison with Previous Survey

We found a total of 90 localities along our transects and a further 50 were discovered off the transects. Without a systematic survey, archaeological locality distributions may be biased towards large sites, in locations that are easily accessible, with high

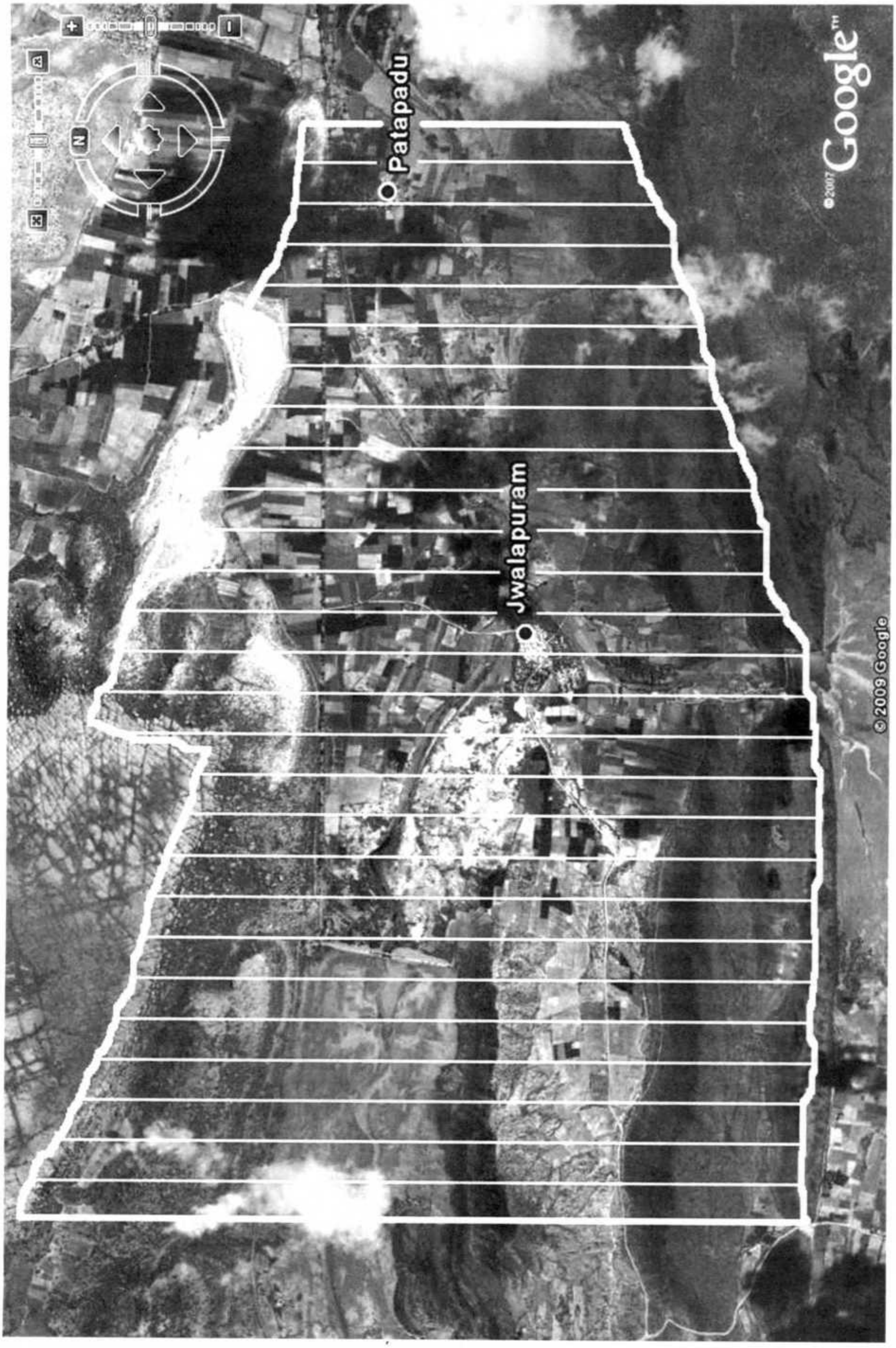

Fig. 5: Transects walked across the survey area

surface visibility. Previous exploration had revealed archaeological localities on Peddakonda, the base of Eddulakonda and on the uncultivated portions of the valley floor. Our systematic survey found that archaeological localities are more widely distributed throughout the valley, both high on the hill slopes and in cultivated fields and may sometimes consist of only a handful of artefacts.

To test the utility of systematic transects we compared the results of the systematic survey with those of an unsystematic, windshield survey carried out in 2003 (Petraglia *et al.* 2008). Using chi-square tests in Excel we compared the proportion of localities by period (Table 1) between the two surveys. Table 1 indicates there is a very significant difference between the transect and unsystematic surveys in terms of archaeological periods, such that Iron Age sites are overrepresented and Neolithic sites are underrepresented in the unsystematic survey. This result may be attributed to the fact that Iron Age sites consist of highly visible Megalithic structures. We then compared the proportion of localities found in fields versus those found in uncultivated areas (Table 2) and found there was a significant bias in the unsystematic survey towards uncultivated areas. This may be explained by the greater surface visibility making it easier to identify sites in the absence of cultivation. We also compared the proportion of localities found in hillsides versus those on the valley floor (Table 3). The results show a significant bias towards localities on the hillsides in the 2003 survey, which we attribute to the targeting of large quartzite rock shelters during this survey. Lastly we compared the number of localities representing each artefact locality between the surveys (Table 4). The results show that in 2003 there was a significant bias towards sites with structures, rock art and human remains and against sites with lithics. Again we attribute this to the greater visibility of structures and the targeting of rock shelters during the 2003 survey. These tests all show that there are significant biases in unsystematic survey which means their results cannot reliably be used to determine human landscape use.

Surveys are constrained by the amount of time, money and people available. For future research we determined the minimum number of transects that it is necessary to walk to get a representative sample of the archaeology in the valley. A chi-square test compared the distribution of localities by period between our survey, with transects every 200 m, and the results obtained if we had walked transects every 400 m and every 800 m. The chi-square p-values in Table 6 show that while the distribution of sites does not differ when transects are walked every 200 m versus every 400 m there is a significant difference in distribution between transects walked every 200 m and every 800 m. We therefore conclude that in order to get a representative sample of archaeology with limited resources the optimal spacing between 10 m wide transects is between 400 and 800 m.

Discussion

With a rigorous assessment of the location, frequency and size of archaeological localities we are able to make some assertions about the human occupation of the valley. The area around the village of Jwalapuram has been a focus for human activity from the Acheulean to the present day. The densest distribution of localities was west of Jwalapuram and east of the Jurreru dam (Fig. 6). This may in part be due to taphonomy as this is the least cultivated area of the valley and as described above it is easier to spot surface artefacts in scrub than under crops. Nonetheless localities reach a high frequency in this area which requires some behavioural explanation; we propose three complementary pull factors bringing hominins to this section of the Jurreru Valley. First, hominins may have been drawn here by the availability of permanent water sources in the form of the Jurreru river and its tributary the Kukkalaganticheruvu (which joins the Jurreru from the south near the village of Jwalapuram). Second, this section of the valley is at the juncture between the hilly regions to the west and the plains to the east. The valley is the largest running through the uplands in for tens of kilometres north and south (Fig 3.) and may have been used as a corridor for animal movements in the past. Third, there is a rich variety of raw materials suitable for lithic manufacture in this part of the valley, including a dark blue siliceous limestone, chert and chalcedony, a fine grained quartzite, quartz, serpentine and dolerite which may have been used as both a substrate and as hammerstones. The combination of permanent water sources, a corridor for animal movements and an abundance of lithic raw materials may have attracted hominins to this part of the Jurreru Valley since the Lower Palaeolithic.

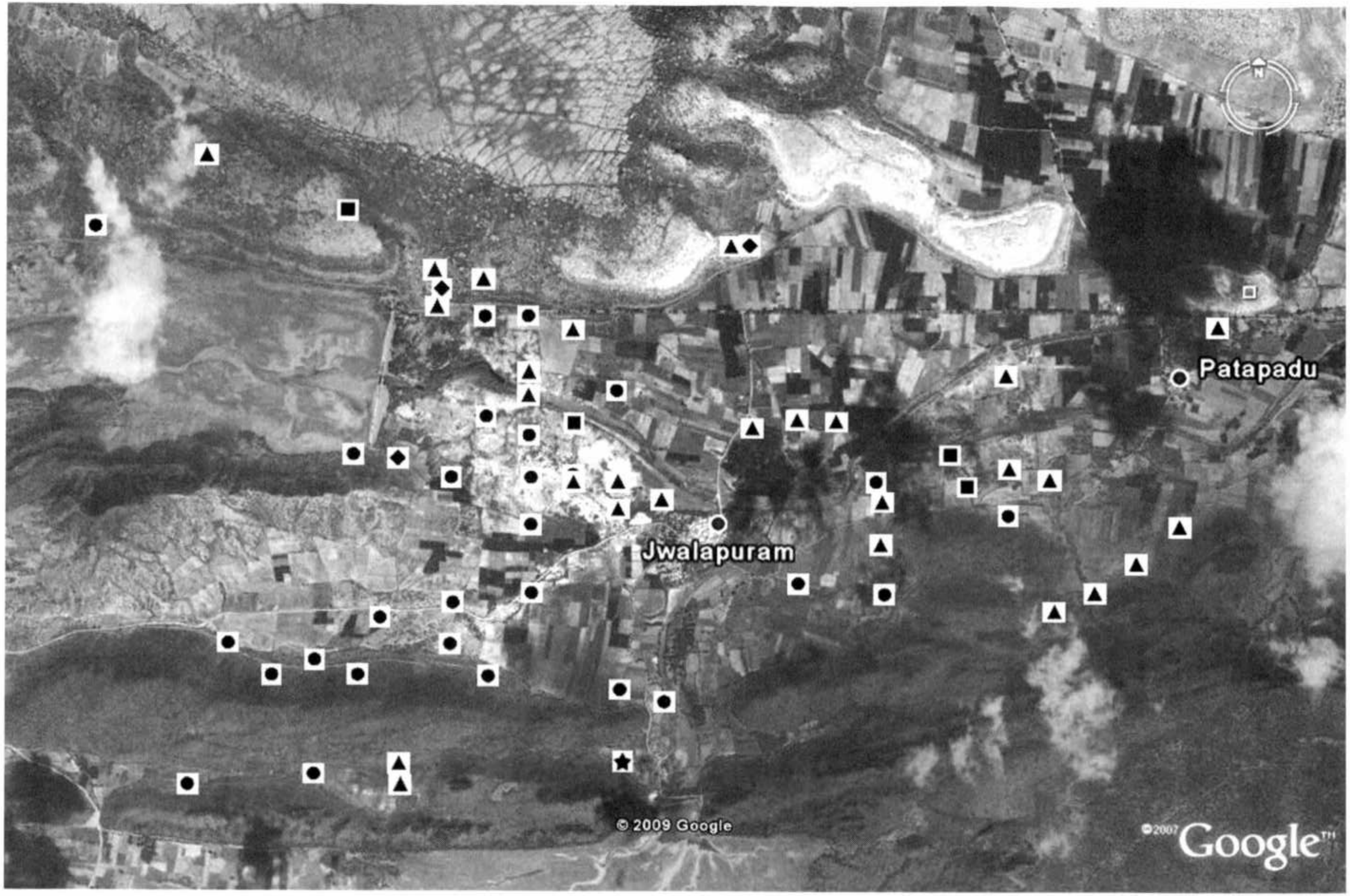

Fig. 6: Sites found on transects in the Jurreru Valley. The star denotes the Acheulean locality, circles indicate Middle Palaeolithic localities, triangles indicate microlithic localities, squares denote Neolithic localities and diamonds denote Iron Age localities.

Systematic survey not only allows identification of where past human activity took place but also of areas where conspicuous activity is absent. Figure 6 shows some interesting empty spots in terms of archaeological localities which may be explained by both taphonomic and behavioural factors. The area behind the dam has clearly filled up with sediment since the dams construction, burying any archaeology. Conversely the low limestone hills on the northern side of the valley are being extensively quarried and any archaeology has been destroyed in the process. In the cultivated areas adjacent the road and south of Jwalapuram archaeological localities are rare due to the difficulties of spotting remains among the most common crops: jowar and rice paddies. Archaeological remains are entirely absent from the hill sides except where they occur in rock shelters, on flat promontories or in one instance in a cave. This reflects the fact that humans avoid steep ground for habitation and other activities which leave an archaeological signature.

The survey encountered a range of localities both in terms of their size and their location on the floor and hill slopes of the valley (Fig. 7). Locality length ranges from 1 to 400 m, while locality elevation ranges from 233 to 495 m above sea level. Figure 6 shows that while most localities were below 65 m in length and situated on the valley floor or the lower slopes; there were also a few very large localities on the valley floor and a few small localities high on the hill slopes. This shows that hominins sometimes lived in large groups on the valley floor. The large sites are mostly ceramic bearing localities and probably represent settled agricultural villages. The smaller localities on the valley floor are from all different periods and represent a variety of different activities and occupations. The very small localities high on the hill slopes are mostly rock art localities, painted on large quartzite boulders. Their small size suggests they were either occupied by small groups, or were only used sporadically, perhaps for ritual activities.

Each period appears to have a particular distribution of localities across the landscape. We encountered only one Acheulean locality at the gap in the dolerite dyke, although we did recover a few isolated bifaces from the base of Eddulakonda and Kuppakonda these were more numerous in the

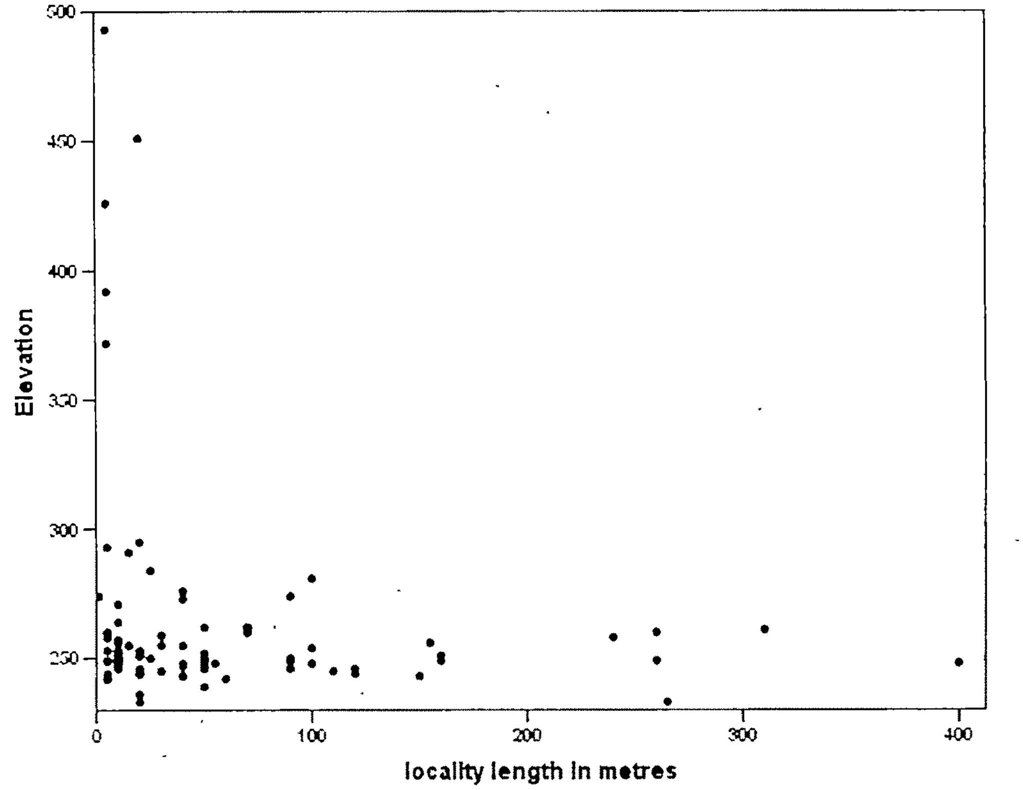

Fig. 7: Locality length by elevation above sea level

Table 1: Locality count by period and survey

Period	**Transect**	**Unsystematic**
Acheulean	1 (1.1)	1 (8.3)
Middle Palaeolithic	33 (36.7)	5 (41.7)
microlithic	27 (30)	3 (25)
Neolithic	4 (4.4)	0 (0)
Iron Age	3 (3.3)	3 (25)
Total	68 (100)	12 (100)
Chi-square p-value	<0.001	
Chi-square p-value		0.452 0.021

Numbers in parentheses indicate the percentage of localities representing each period in the survey. Localities of unknown period are not included.

Table 2: Localities found in fields versus uncultivated areas by survey type

	Transect	**Unsystematic**
Fields	33 (36.7)	1 (7.1)
Uncultivated	57 (63.3)	13 (92.9)
Total	90 (100)	14 (100)
Chi-square p-value		<0.001

Numbers in parentheses indicate percentage of all localities found on the survey.

Table 3: Localities found on hillsides versus the valley floor by survey type.

	Transect	**Unsystematic**
Hillside	5 (5.6)	2 (14.3)
Valley Floor	85 (94.4)	12 (85.7)
Total	90 (100)	14 (100)
Chi-square p-value		<0.001

Numbers in parentheses indicate percentage of all localities found on the survey.

Middle Palaeolithic localities (Fig. 4). On several transects west of the gap in the dolerite dyke we found Late Palaeolithic artefacts running from the base of Eddulakonda on the valley floor for up to height of 100 m. The principal raw material used by Middle Palaeolithic hominins was the dark blue siliceous limestone that occurs as a stratum within Eddulakonda, so hominins appear to have been extensively exploiting this material at, or close to, the source. In addition to these localities on the southern side of valley, were several Middle Palaeolithic localities of varying size and density across the valley floor. Despite the high frequency and often high artefact density of Middle Palaeolithic localities, they were restricted spatially, with no localities found on the hill slopes or the quartzite plateau. Middle Palaeolithic hominins were apparently based close to their raw material sources and were not exploiting the uplands to a significant degree. In this resource rich section of the valley Middle Palaeolithic groups may have had no need to heavily exploit the more inaccessible areas of the landscape.

In contrast to the Middle Palaeolithic localities, microlithic localities were encountered throughout more evenly across the landscape. Microliths and rock art had previously been identified on the lower quartzite boulder rock shelters, such as Jwalapuram 9. As a result of transect sampling we found three more rock shelters with rock art and microliths in association, on boulders high up the slope of Peddakonda (JWP 27, JWP 134 and JWP 135). Many of the artefact localities found across the valley floor included microliths, although some also included other types of lithics and ceramics and probably represent the conflation of multiple periods on an eroding surface. On the southern side of the valley we found several discrete microlith localities on the hill slopes. JWP 112 and JWP 113 in particular stand out for their high density (over 1 artefact per m^2), and their location on flat promontories on hillsides suggesting they were living areas. On the northern side of the valley two microlith localities were identified on the tops of the low limestone hills which extend eastwards from Peddakonda (JWP 101 and PTP 22). Another microlith locality was discovered on the quartzite plateau itself (PNM 18). This increased landscape use in comparison to the Middle Palaeolithic may be due to increased population pressure (Petraglia *et al.* 2009) resulting in the need to forage more widely.

Table 4: Number of localities containing each artefact category by survey type

Artefact Categories	Transect	Unsystematic
Lithics	87 (74.4)	11 (40.7)
Ceramics	20 (17.1)	5 (18.5)
Structures	4 (3.4)	3 (11.1)
Rock Art	4 (3.4)	6 (22.2)
Human Remains	2 (1.7)	2 (7.4)
Chi-square p-value		<0.001

Numbers in parentheses indicate percentage of all category counts by survey.

Table 5: Locality types by period for different transect densities.

	Spacing Between Transects		
Period	**200 m**	**400 m**	**800 m**
Acheulean	1(1.1)	1(2.1)	1(3.9)
Middle Palaeolithic	33(36.7)	23(47.9)	11(42.3)
microlithic	27(30)	14(29.2)	7(26.9)
Neolithic	4(4.4)	3(6.25)	2(7.7)
Iron Age	3(3.3)	1(2.1)	1(3.9)
Chi-square p-value		0.452	0.021

Numbers in parentheses indicate locality percentage represented by each period. Chi-squared p-values compare 400 and 800 m spaced transects with 200 m spaced transects. N.B. sites of unknown period are not included.

Table 6: Kruskall-Wallis test comparing artefact density across periods

	Mean artefact density
Acheulean	1.2
Middle Palaeolithic	1.302
Microlithic	1.688
Neolithic	1.818
Iron Age	2.429

Kruskall-Wallis p-value = 0.002

Southwest of Patapadu, we found a large Neolithic artefact locality (PTP 2) which stretches for over 150 m with a medium to high density of lithics and ceramics, including Neolithic Patapadu ware. This locality is assumed to be the location of a former village. Several rock art localities on the quartzite boulders and cliffs are associated with Neolithic pottery (JWP 34, JWP 61 and JWP 131). These are particularly interesting because they indicate continuity with the preceding microlithic period or interaction between Neolithic populations inhabiting the plains and hunter-gatherers occupying the hills. A small cave (Fig. 4) was discovered containing a Neolithic burial with grave goods (JWP 133); fragments of human long bones and some handmade and finger pinched pottery sherds were observed.

During the survey four Megalithic burial complexes were encountered, two on transects and two off transects. The smallest of these comprised two cist burials at the eastern end of Kuppakonda (JWP 45). The second burial complex (JWP 101) was located on the low limestone hill running eastwards from the eastern corner of Peddakonda. This consisted of at least 4 cist burials with human remains and grave goods in evidence. The third burial complex (JWP 31) was located at the base of Peddakonda. This comprised five large cairns each containing multiple cist burials, the largest cairn measured 14 x 7 metres. The fourth burial complex (PTP 26) was found south of the village of Patapadu near the base of Eddulakonda. This complex comprised several large cairns made of dolerite cobbles within an elliptical arrangement of dolerite boulders. During our field season we also encountered a very large megalithic burial ground (YAG 1) just outside the range of our survey, close to the Yaganti temple. Here we counted over 50 separate burial monuments conforming to a pattern of a rectangular cist surrounded by a circular arrangement of stones. Within the survey area we also saw a modern cist burial, which appeared to contain more than one individual. We found one rock art locality with sherds of black and red ware (JWP 136), a pottery style that has been linked to the early Iron Age (Fuller *et al.* 2007). During excavation iron slag and pottery were discovered at locality JWP 38 at the eastern end of Kuppakonda. This locality is probably part of a large adjacent lithic and ceramic bearing site, and may well be an Iron Age village.

In order to assess chronological trends in settlement patterns we compared artefact density across the periods. Table 6 shows there are trends for increasing density of localities throughout the ages. A Kruskall-Wallis test showed this pattern to be highly significant. We interpret this as reflecting a trend towards increasing sedentism from the microlithic onwards, so that as people were repeatedly using the same localities this caused a build up of higher artefact densities. These comparisons were done using both on and off transect localities in order to increase sample size; when only transect localities were compared the statistical results were the same.

Conclusion

This article has demonstrated that unsystematic survey can result in significant bias in the periods, environment, location and types of material observed. Transect surveys provide a robust method for determining the true spatial distribution of archaeological localities within a given area. With this information we can begin to make assertions about the demography and landscape use of past populations, thus situating excavated localities in their local context and enhancing our understanding of human behaviour. In the Jurreru Valley systematic survey data has illustrated the intense, but restricted occupation of the valley in the Middle Palaeolithic; the expansion of landscape during the microlithic; and the general trend for an increase in artefact density over time, which we interpret as reflecting increasing sedentism. We hope that such surveys will be employed to enabling rigorous analysis of the landscape use and demography of past populations.

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Changing Patterns of Settlement in the Rise and Fall of Harappan Urbanism and Beyond: a Preliminary Report on the Rakhigarhi Hinterland Survey 2009

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Abstract

This paper presents a report of the Rakhigarhi Hinterland survey, which was a focused village-to-village survey of the hinterland of the major urban site of Rakhigarhi, in District Hissar, Haryana, India. During August and September 2009, a total of 127 sites were visited, and a sizable proportion of these sites, from all periods, were previously unknown. The results of this survey highlight a number of problems with the existing site distribution data sets and have important ramifications for our understanding of the dynamics of settlement in Haryana throughout proto- and early history. They will also make an important contribution to our understanding of the rise of cities in western India during the period of the Indus Civilisation.

Introduction

A large number of archaeological surveys have been carried out across the plains of northwest India, resulting in the discovery of literally hundreds of archaeological sites of various periods, spanning from the beginnings of settled village life in the 3rd millennium B.C. and earlier, up to the Historic and Mediaeval periods. Most syntheses of these surveys have focussed on the evidence for proto-historic settlement patterns (e.g. Joshi *et al.* 1984; Possehl 1999; Kumar 2009), and discussions that take account of the entire chronological span of occupation have been the exception (e.g. Chakrabarti and Saini 2009; Dangi 2009a, 2009b). This region lies in the critical zone between the Indus and Gangetic hydrological systems, and this means that it is one of the most important regions in the subcontinent for understanding major cultural transitions, particularly the rise and fall of the urban centres of the Indus Civilisation during the 3rd and 2nd millennia B.C, and the subsequent reappearance of urban centres in the Ganga Valley during the 1st millennium B.C.

A multidisciplinary collaborative venture entitled the *Land, Water and Settlement Project* and consisting of researchers from Banaras Hindu University (BHU), the University of Cambridge, the University of Oxford, Imperial College London, the Indian Institute of Technology Kanpur, and the Uttar Pradesh State Archaeology Department, began analyses on the archaeology and environment of the plains of Haryana and western Uttar Pradesh in 2008 (Singh *et al.* 2008). Up to the end of 2009, the archaeological component of this research has included a reconnaissance of a number of Harappan and later period sites in western Uttar Pradesh (UP) and Haryana (April-May 2008), excavations at the site of Alamgirpur (May 2008), excavations at two sites at Masudpur (April-May, December 2009), and a detailed survey of the hinterland of the urban Harappan site of Rakhigarhi (Aug-Sept 2009) (Singh *et al.* 2008, 2009; Petrie *et al.* 2009). This paper will outline the results of a preliminary reconnaissance conducted across parts of Haryana and western UP in 2008, a report of which was published in a previous issue of this journal (Singh *et al.* 2008). It will then present the preliminary results of a targeted survey of the hinterland of the urban Indus Civilisation site of Rakhigarhi, the largest proto-historic site in northwest India and is situated in Hisar District, Haryana.

Identifying Problems of Context: the Reconnaissance Survey in 2008

The initial reconnaissance survey conducted by the *Land, Water and Settlement Project* in 2008 aimed

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to establish the relationship between archaeological sites and their geographical and landscape context in two primary zones: the area northeast and east of New Delhi in western UP; and the central Haryana Plains, between Hisar and Karnal (Singh *et al.* 2008). These areas were specifically chosen because of their geographical relationship to the present courses of the perennial Yamuna and Hindon Rivers at the eastern end of our area of interest (Districts Meerut, Baghpat, Gautam Buddha Nagar and Ghaziabad, western UP), and of the ephemeral Ghaggar, Sarsuti and Chautang Rivers and associated nullahs to the west (Districts Bhiwani, Hisar, Jind and Karnal, Haryana and the southernmost parts of District Patiala, Punjab) (Fig. 1). During the reconnaissance, the project team recorded the condition of sites, and made surface collections to establish the periods in which they were occupied. The location of these sites was established using early twentieth century Survey of India maps, which often show the location of mounds, and a global positioning system or GPS receiver (Singh *et al.* 2008).

The reconnaissance survey produced a number of significant results relating to the location and distribution of proto-historic and historic settlements, the preservation of those settlements, and the geographical landscapes within which those settlements lie. This survey has been presented in detail previously (Singh *et al.* 2008), but as it provided the primary impetus for the more focussed survey around Rakhigarhi, it is important to briefly review the major findings. Two interrelated discoveries with regard to site location and distribution were made: firstly, there are significant errors in the published geographic locations of a large number of sites in both western UP and Haryana. By far the majority of the site locations that have previously been published have been presented in a latitude/longitude (easting/northing) format using degrees and minutes only (e.g. Bhan 1975; Joshi et al. 1984; Possehl 1999; Kumar 2009). The absence of seconds, or minutes with a decimal place, from site locations means that there is an inherent vagary in these data, and this has resulted in errors in site locations that range from several hundred metres to several kilometres. Furthermore, there are a number of site locations that are out by significant margins, suggesting that there may be actual errors in the original data. This issue has been noted previously (Law n.d.; Cork 2006) and thus far it has only been possible to correct the locations of a small number of sites. The reconnaissance in 2008 has made it possible to correct the locations of several important sites, including Banawali and Alamgirpur, the latter of which was out by 10 km and had been placed on the wrong side of the Hindon River. One of the by-products of the survey was that it was possible to establish that a large number of sites are located at some distance from the modern relict water courses, while others are actually located on the banks of ephemeral nullahs rather than rivers. The significance of this will be explored further below. Secondly, during the reconnaissance it was also observed that a number of villages including Rakhi Khas and Rakhi Shapur, which overlie Rakhigarhi, and other villages in the same area such as Lohari Ragho, appear to have been built on significantly elevated ground. The plains of Haryana and western UP are predominantly flat and areas of sharp elevation are typically either sand dunes or archaeological sites. This makes it likely that most of the modern villages situated on elevations are actually built on top of sand dunes and/or archaeological sites. This has particular significance when it is noted that many of these elevated villages are not included in the lists of known prehistoric archaeological sites.

The combination of errors in site location and the likelihood that numerous sites are missing from the current lists of site distributions has major ramifications for our understanding of the distribution of proto-historic and historic settlements, particularly when it comes to understanding the environmental context of sites. Any attempts to assess the geographical context of the prehistoric archaeological sites in Haryana and western UP using the existing data set of prehistoric site locations are thus likely to be fundamentally flawed. This is of critical importance when it comes to interpreting the landscape contexts of Harappan and later sites, particularly the relationship between archaeological sites and the relic river channels that are in evidence across the plain. In fact, the substantial inaccuracies in the existing archaeological data set critically impede our understanding of the precise relationship between archaeological sites and the palaeo-channels seen on satellite imagery. With these limitations in mind, the *Land, Water and Settlement* project conducted a detailed survey in the hinterland of Rakhigarhi in order to accurately locate sites within a 15 km radius of the major Harappan urban centre in

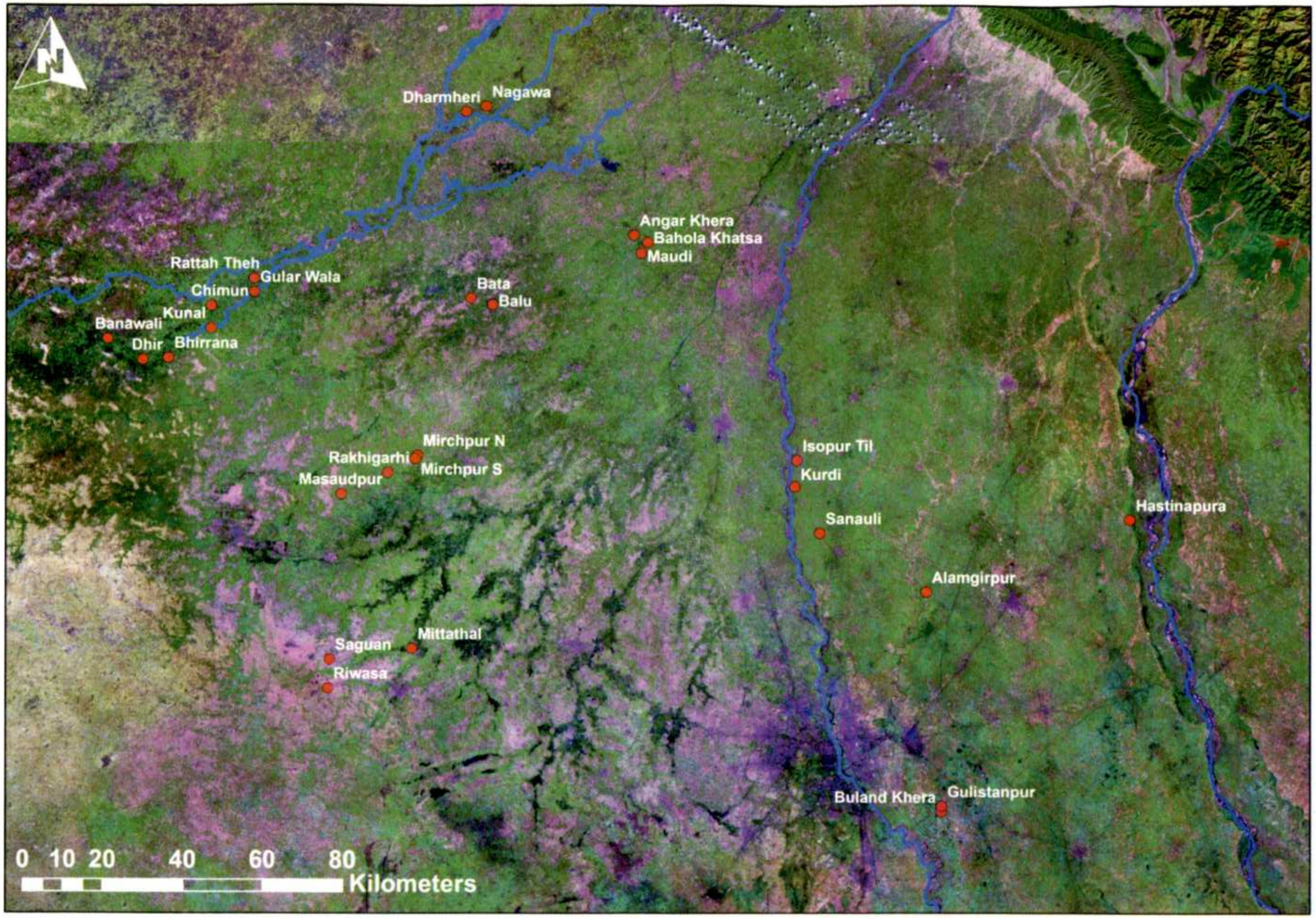

Fig. 1: Colour composite Landsat image of the plains of Haryana, the eastern Punjab and western UP showing the sites visited by the Land, Water and Settlement Project in 2008. Major perennial and ephemeral rivers are shown in blue.

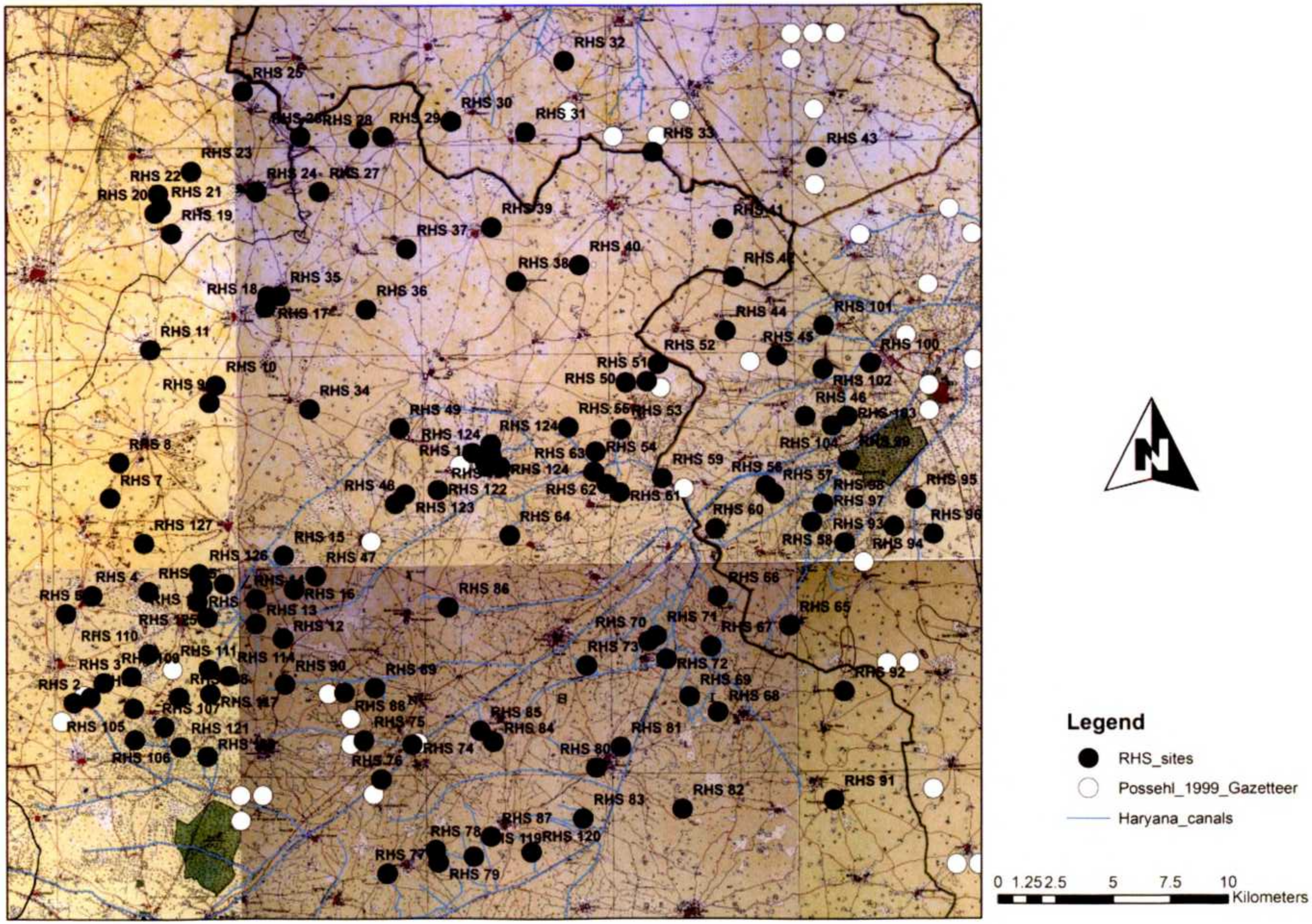

Fig. 2: Composite map of British Period 1" to 1 mile maps of the area around Rakhigarhi, which is the cluster of dots at the centre. Sites listed on Possehl's (1999) gazetteer are shown in green. Sites recorded during the Rakhigarhi Hinterland Survey are shown in purple.

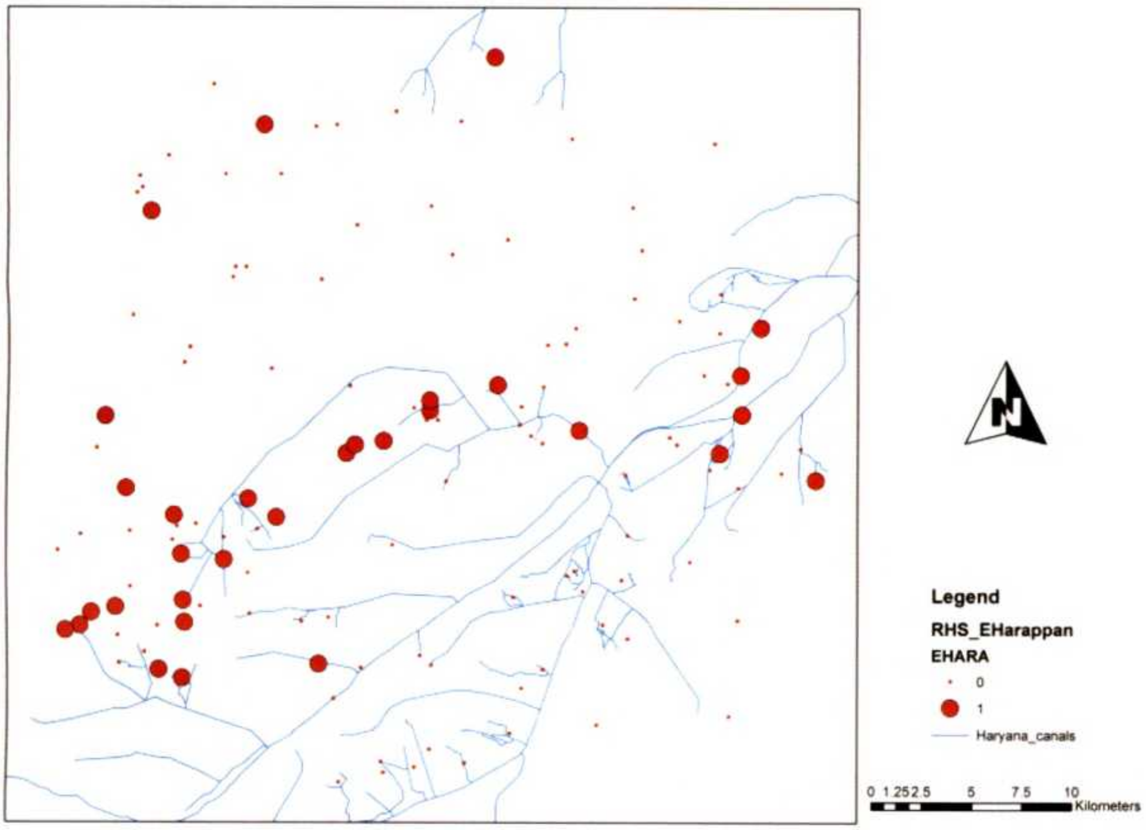

Fig. 3: Early Harappan sites recorded during the Rakhigarhi Hinterland Survey. Rakhigarhi is the cluster of two dots at the centre. Modern canals are shown in blue.

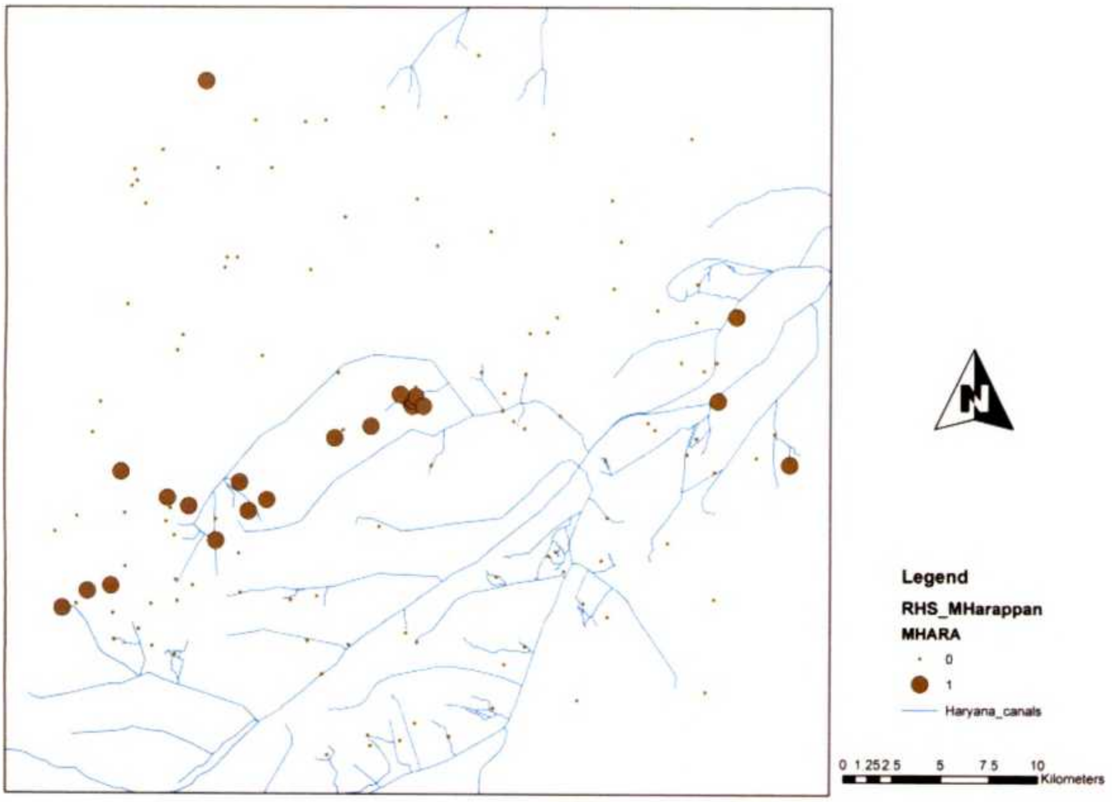

Fig. 4: Mature Harappan sites recorded during the Rakhigarhi Hinterland Survey. Rakhigarhi is the cluster of six dots at the centre. Note the alignment of sites "downstream" from the urban centre. Modern canals are shown in blue.

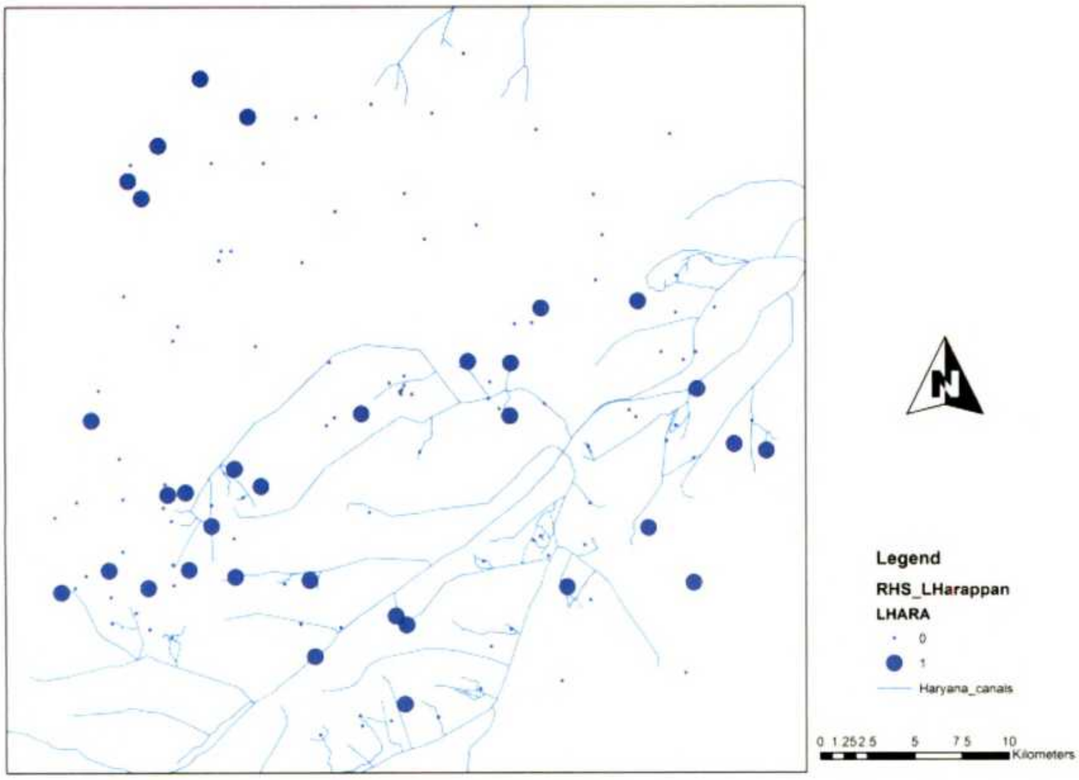

Fig. 5: Late Harappan sites recorded during the Rakhigarhi Hinterland Survey. Sites are clustered in the same areas as in previous periods. Modern canals are shown in blue.

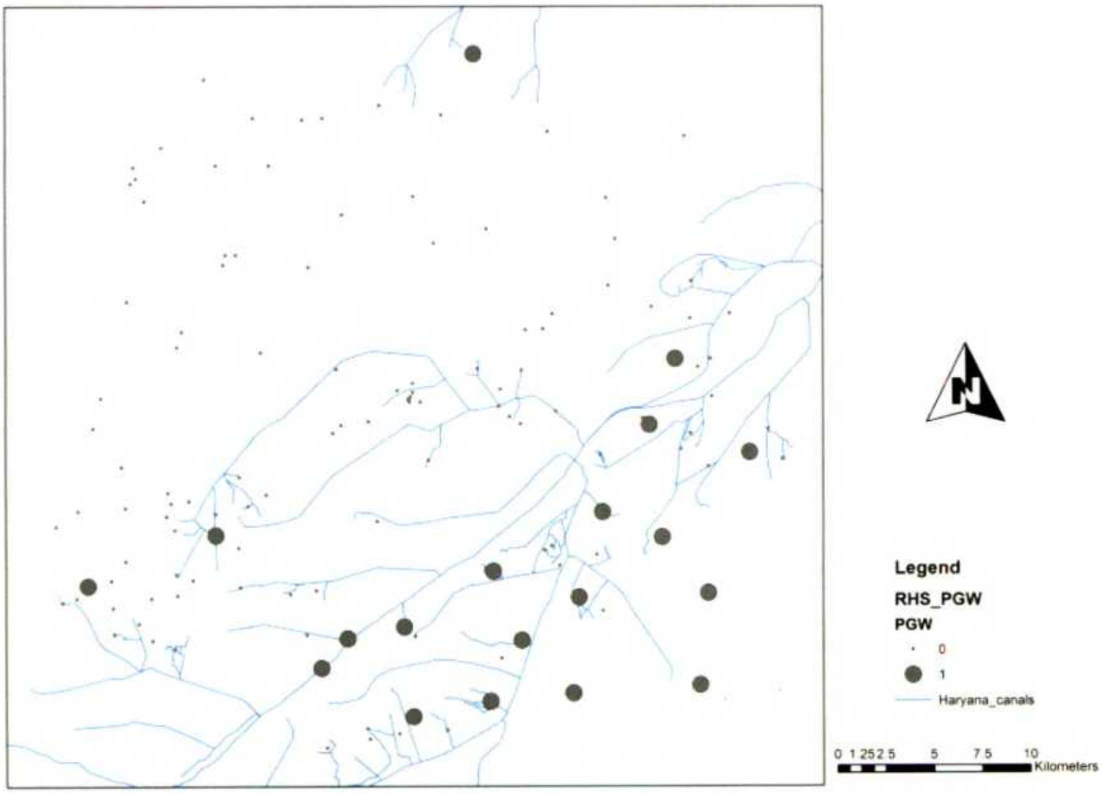

Fig. 6: PGW sites recorded during the Rakhigarhi Hinterland Survey. Sites have a completely different alignment to previous periods. Modern canals are shown in blue.

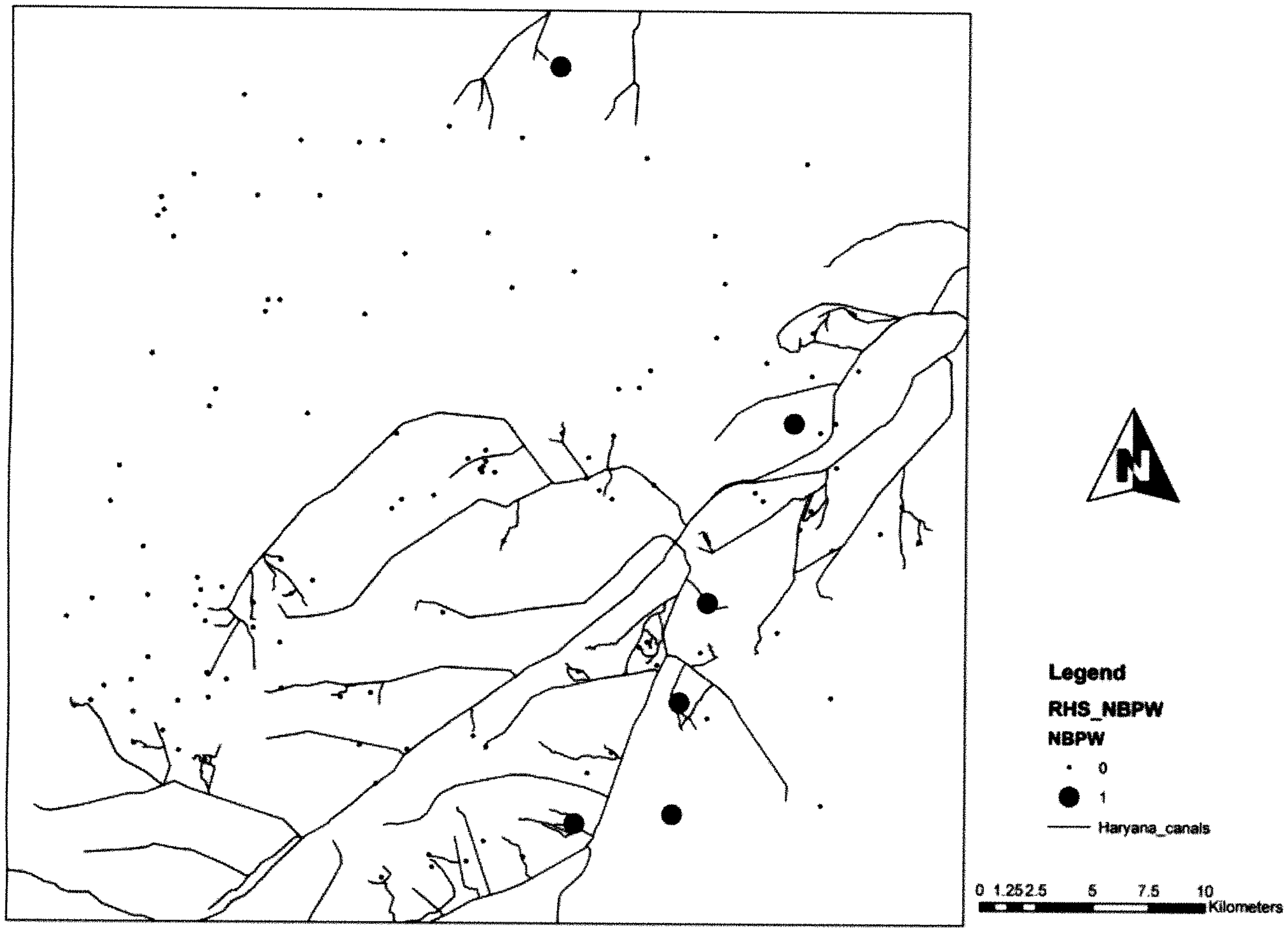

Fig. 7: NBPW sites recorded during the Rakhigarhi Hinterland Survey. Alignment of sites is similar to PGW period. Modern canals are shown in blue.

north west India and to thereby understand temporal and spatial change in settlement distribution in its hinterland.

Addressing Problems of Context: the Rakhigarhi Hinterland Survey in 2009

Mature Harappan occupation at the urban site of Rakhigarhi was first described by Suraj Bhan (IAR 1963-64:90, 1980-81:16; Bhan 1975: 95-101). The site has been subsequently listed in various site registers (IAR 1966-67:12, 1980-81:16, 1987-88: 27; Joshi *et al.* 1984; Possehl 1999: 813; Singh *et al.* 2008: 83; Kumar 2009), and it is also notable that the mounds are visible on British period1" to 1 mile maps. Stratigraphic excavations at the site were commenced in 1997-98 under the direction of Amarendra Nath and P.K. Mishra and continued in 1998-99 and 1999-2000. No detailed report of the excavations has yet been published, but preliminary reports on all seasons are available (IAR 1997-98: 13-24, 1998-99: 55-63; Nath 1998, 1999, 2001). The excavations have suggested that the site was occupied during the Early and Mature Harappan periods (Periods I and II) (Nath 2001), which indicates that it might have been abandoned before the Late Harappan phase. There is some possibility that there is some post-Mature Harappan occupation that has not yet been identified.

In his earliest descriptions of Rakhigarhi, Suraj Bhan noted (1975: 95) that the site was located on the course of the dry Drishadvati, and this assertion appears to have primarily been based on the presence of a depression to the east of the mounds. This association between the site and a relict river is now repeated in most reviews (e.g. Nath 1998; Possehl 2002: 71-2; Chakrabarti 2006: 159). It is, however, notable that the channel is not clearly visible on the ground, and it is not marked on British period

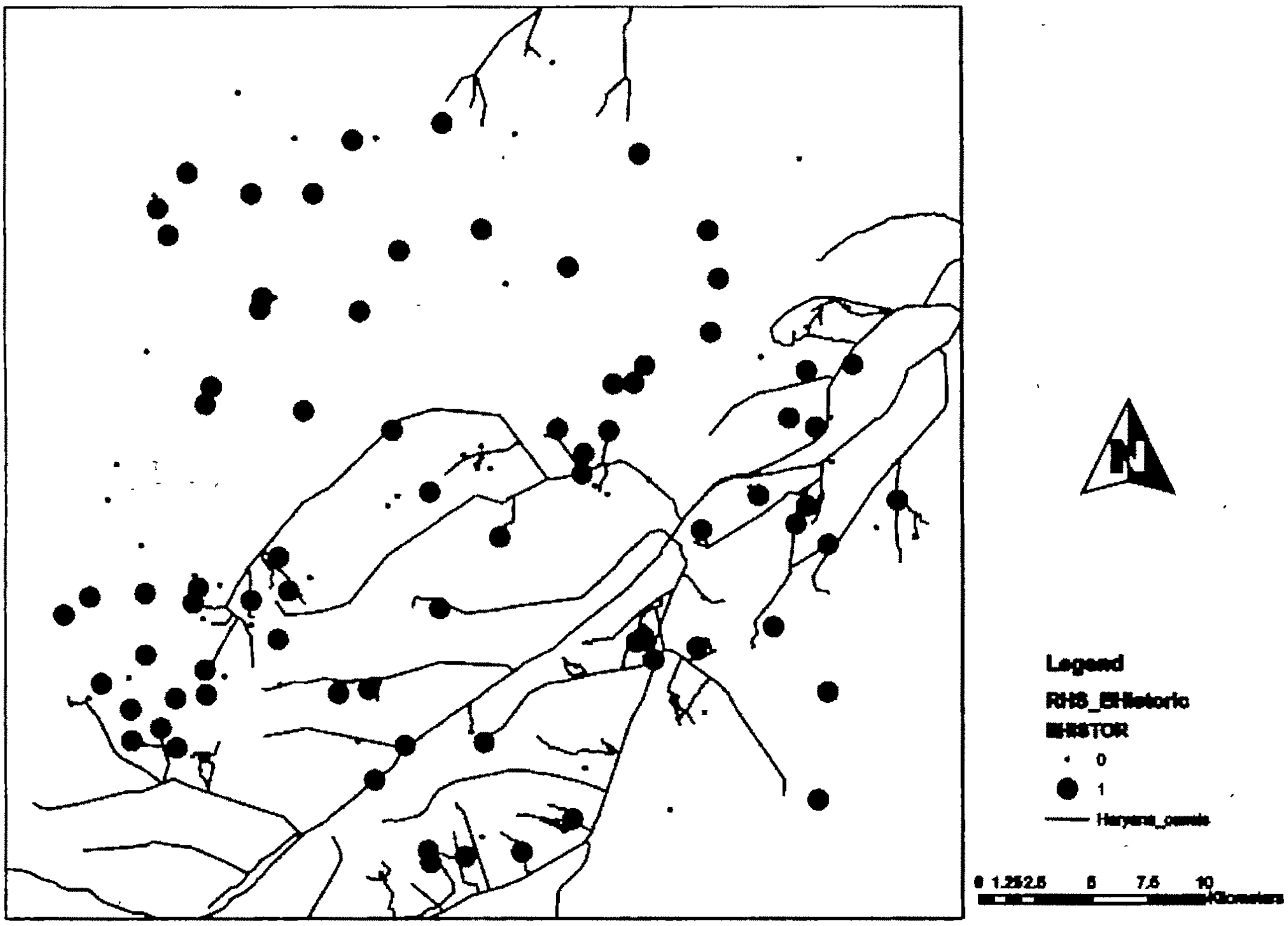

Fig. 8: Early Historic sites recorded during the Rakhigarhi Hinterland Survey. Sites distributed throughout the survey area. Modern canals are shown in blue.

1 inch to 1 mile maps from the early decades of the twentieth century. It is also notable that the modern villages of Rakhi Khas and Rakhi Shapur, which overlie the ancient city, are surrounded by very large ponds, some of which are permanently filled, and some of which appear to fill during the monsoon (Singh *et al.* 2008: 83). Large ponds and/or areas of shallow depressions are also visible on British period 1 inch to 1 mile maps.

On the basis of size alone, Rakhigarhi is certainly the largest, and was potentially the most important Harappan site in northwest India. However, the limited duration and scale of the excavations has meant that we have a relatively limited understanding of the processes of urban development and decline at the site. In addition, as no detailed survey focussing on the nature of archaeological settlement in the hinterland of the site has ever been published, we also have a relatively poor understanding of the impact that the rise and fall of urban Rakhigarhi had on its hinterland.

As noted in the introduction to this paper, a large number of surveys have been carried out in different parts of Haryana, and these have largely been conducted by M.Phil. and Ph.D. students from Kurukshetra University and M.D. University in Rohtak (Possehl 1999; Kumar 2009; Chakrabarti and Saini 2009). While there have been attempts to combine the data from these various surveys (e.g. Kumar 2009), there are a number of limitations to these data. In general the surveys have focussed on individual tehsils, blocks and/or districts. As a result of this approach, no survey has used the proto-historic landscape as a basis for its analysis. Areas that have been surveyed intensively typically have high densities of sites (e.g. Dangi 2009a, 2009b), while adjacent areas have often been surveyed in less detail or not at all. The results of the surveys are

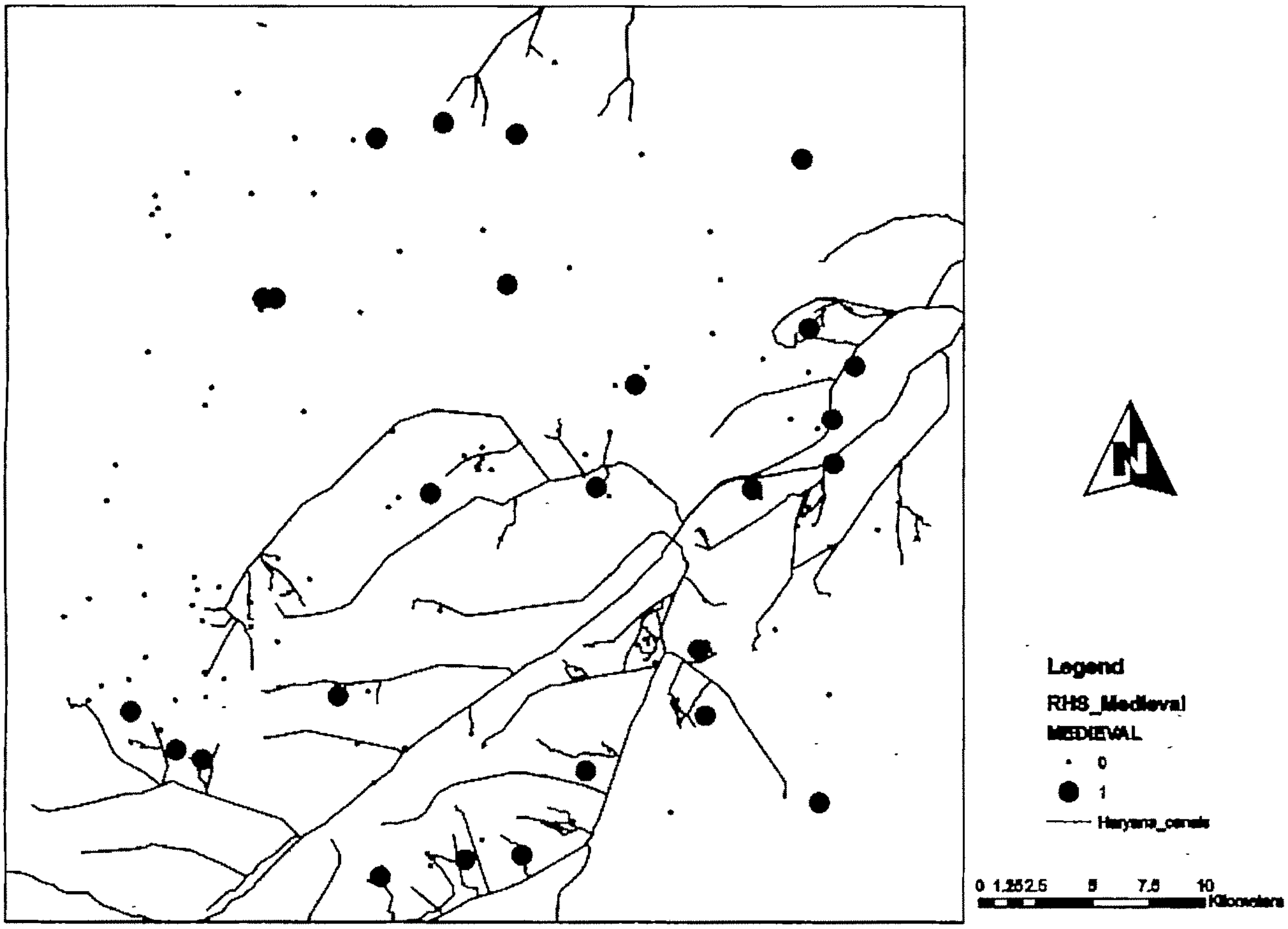

Fig. 9: Medieval sites recorded during the Rakhigarhi Hinterland Survey. Sites distributed throughout the survey area, but in less frequency than in the Early Historic period. Modern canals are shown in blue.

also somewhat variable, as some have seen the use of GPS equipment to locate sites accurately, while others have relied on locating sites using latitude/longitude (easting/northing) format using degrees and minutes only, resulting in problems of imprecision (see above). There is also the problem of the names attributed to sites. Often the name of the closest village is used to identify several sites, and while they are given separate numbers, there are several instances where only one geographical co-ordinate is given for several sites (e.g. Masudpur I-IV; Joshi *et al.* 1984; Possehl 1999). When more than one survey has been carried out in a particular area there are often differences in the locations given for particular sites and variant spellings are also common (see below). All of these limitations result make it difficult to reassess much of the published data.

To establish the geographical context of archaeological sites in the immediate hinterland of Rakhigarhi, and to gain insight into the spatial and temporal variation of sites within this zone, the the *Land, Water and Settlement Project* carried out a systematic village-to-village survey of the area within a 15 km radius of the site in August-September 2009 (Fig. 2). This has been called the *Rakhigarhi Hinterland Survey.* One of the objectives of this survey was to revisit all known Harappan period sites in the study area in order to establish their precise location, size and to determine when they were occupied. It was thought that there would be a significant number of previously unidentified sites in this region, so widespread coverage was attempted within the target area. It was also hoped that the precise relationship between the archaeological sites and the modern and ancient water courses that are preserved across the plains would be demonstrated, thereby providing a clear impression of the relationship between settlement, water resources and the landscape.

The results of this survey are still being processed, but it is possible to venture some tentative conclusions based on the spatial and temporal distribution of these sites, and their landscape context as it can be reconstructed using British period 1 inch to 1 mile maps, more recent satellite imagery, and observations made on the ground. A total of 127 sites were located during this survey (Table 1). Up to 73 of these have not been recorded in previous survey reports and compilations (e.g. Joshi *et al.* 1984; Possehl 1999; Kumar 2009; Chakrabarti and Saini 2009), meaning that up to 57% of sites within this particular area are new to knowledge. The chronological distribution of these sites is not skewed to any one period, and in all but the Late Harappan phase, up to 50% of sites have not been recorded previously (Table 2). The Early Historic period has the highest number and proportion of new sites (48 sites, 61.5%; Table 2). One interesting discovery of the survey was that the newly discovered sites largely appear in clusters in the vicinity of particular villages, suggesting that many villages in the target area had not been surveyed previously. This highlights the potential problems that might arise from relying on modern administrative boundaries to dictate the limits of survey coverage.

The number of sites dating to each period is as follows: 29 Early Harappan, 15 Mature Harappan, 32 Late Harappan, 18 PGW, 6 NBPW, 78 Early Historic and 26 Medieval (Table 2), with the urban site of Rakhigarhi being occupied only in the Early and Mature Harappan periods. The distribution of sites in each of these periods is shown in Figs. 3-9. The variation in site numbers suggests that the Mature Harappan period saw a centralisation of the local Early Harappan population, which then dispersed again during the Late Harappan period, which is a pattern that might be predicted for periods of urbanisation and de-urbanisation. The survey has also shown that there is considerable change in the location and concentration of sites over time. Many of the sites appear to be distributed in linear alignments, particularly during the Early, Mature and Late Harappan periods, and also to some extent during the PGW and NBPW phases. Such a distribution implies that these sites were located along water courses rather than their being randomly distributed across a landscape watered by rainfall. It is not precisely clear, however, whether this indicates that the sites were located on perennial rivers, ephemeral rivers/nullahs or artificial canals. If they were water courses, the distribution pattern also suggests that these may have intersected and/or bifurcated at different points. It is notable that this major alignment that lines up with Rakhigarhi does not coincide with any of the major canals that traverse the plains today.

With the shift from the Early to the Mature Harappan phase, a number of sites that appear to be 'downstream' from Rakhigarhi and several other sites in the hinterland are abandoned (compare Fig. 3 and 4). Several of these sites and others in close proximity to earlier sites appear to be reoccupied during the Late Harappan period, and some parts of the hinterland appear to be settled for the first time (Fig. 5). Many of these sites appear on the linear alignment that passes through Rakhigarhi, and if this indicates the presence of a water course, it does not appear to have been dry during the Late Harappan period (Fig. 5). The major change in settlement distribution appears to come with the Painted Grey Ware or PGW period, where the alignment of sites that passes through to Rakhigarhi disappears, and the main concentration of settlement appears to shift to the south. The PGW settlements also show some degree of alignment, yet in contrast to the major alignment of the Early, Mature and Late Harappan periods, the PGW sites mostly lie in close proximity to many of the modern canals (Fig. 6). Northern Black Polished Ware or NPBW only appears on sites that also have PGW and were only found in a relatively limited area to the south (Fig. 7). In general, Early Historic and Mediaeval period sites are distributed evenly across the whole of the study area, with the Early Historic period showing the highest density of settlement (Figs. 8-9). There are several sites that appear to have been occupied in more than one period, and of these, Roda Khera appears to have been occupied throughout the Early, Mature and Late Harappan phases and also the Early Historic period, and thus might provide an important perspective on the processes of cultural change over this protracted period. Other sites such as Jhauwala Khera and Igra appear to have been occupied in both the Late Harappan and Painted Grey Ware phases, and have the potential to provide important insight into this critical phase of transition. More elaborate discussions based on assessments of the size of particular sites during specific periods will have to await further analysis.

The results of the *Rakhigarhi Hinterland Survey* could be taken to provide some corroboration of Chakrabarti's suggestion (1988, 1999: 327, 2006: 144, 2008; Chakrabarti and Saini 2009: 37) that Harappan agriculture, at least in northwest India, might have depended on an extensive irrigation network. It is notable that the main alignment of Early, Mature and Late Harappan sites does not coincide with any of the modern canals, whereas the PGW sites to some extent do. A factor that is potentially significant is that the remote sensing analysis that has been carried out thus far has not paid specific attention to the location of modern canals, and the impact that these might have on imagery. Most of the modern canals appear to coincide with the large linear features visible on the satellite imagery that are typically identified as palaeo-channels. This is interesting, as the palaeo-channel visible on satellite imagery that is commonly identified as the Drishadvati does not actually appear to pass close to Rakhigarhi, but some distance to the south. What is visible on the satellite images may be evidence for an abandoned river channel or canal system, but this suggestion is as speculative and must be tested on the ground. Until further analysis is carried out, it is not possible to push this discussion further.

Discussion and Suggestions for the Future

The work of the *Land, Water and Settlement* project has shown that the locations of large numbers of sites that appear in many of the site registers are incorrect, and this makes it impossible to discuss past settlement and/or landscape dynamics on the plains of northwest India with any substantiation. It is also clear that many modern villages appear to overlie ancient sites, and that many sites have not previously been recorded. These two factors indicate that the current estimates of site frequency in northwest India are almost certainly too low. As most of the surveys that have been carried out in the past have not been problem oriented, it is difficult to draw broader conclusions about settlement dynamics.

Many proto-historic sites appear to be distributed in linear alignments, but this is not the case for all sites. This suggests that not all sites lay on major rivers or canals. It is not yet clear whether any of these watercourses were perennial during the proto- or Early Historic periods, and this can only probably be demonstrated through systematic sub-surface coring in relevant areas. The most recent synthesis of the survey evidence by Kumar (2009) has shown that sites with evidence for occupation during the Early, Middle and/or Late Harappan phase are widely distributed across the plains of Haryana. It is also clear that many of the larger/most significant sites lie on different parts of the plain, and in contrast to the claim that a large number of Harappan sites are located along the course of these channels (e.g. Valdiya 2002: Figs 4.3, 4.5; Bhadra *et al.* 2009: 278-280), the proposed course of the Ghaggar/Saraswati actually has far fewer sites than the regions around Rakhigarhi, which appears to be the case for the Early, Mature and Late Harappan periods (Kumar 2009: Figs. 6-9). It is true that important sites like Banawali, Kunal and Bhirrana all lie in close proximity to the Ghaggar or one of the other ephemeral streams that ultimately flow into that water course, but Rakhigarhi and Farmana, which are the largest Harappan sites on the plain, are located some distance to the south, and each of these is in turn located in a different part of the plain. While the results of the *Rakhigarhi Hinterland Survey* potentially indicate the existence of a large water course or canal that ran on an alignment close to Rakhigarhi, Farmana is located some distance further to the east. This important site was almost certainly provided with water from yet another source, be it a watercourse, canal or managed rainfall.

It is not yet clear how the complex distribution pattern of Mature Harappan sites should be explained, but there are several factors that deserve consideration. The reconnaissance survey highlighted that a large number of sites are located at some distance from the modern relict water courses, while others are actually located on the banks of ephemeral nullahs rather than rivers. The variation in site distribution suggests that the inhabitants of the plains of Haryana probably used a range of water sources throughout the year, much as happens today. There is a tendency to assume that the Harappan agricultural system was homogenous, but it seems far more likely that variation in local environmental conditions and water supply necessitated variation in practices. It might be presumed that where perennial and ephemeral water courses were present, they were exploited, and where they were not, the inhabitants relied on canals, ponds and rainfall, the latter being important particularly in those areas that receive

Table 1: List of sites recorded during the Rakhigarhi Hinterland Survey. Site locations established using a Garmin GPS. Abbreviations EHar = Early Harappan, MHar = Mature Harappan, LHar = Late Harappan, PGW = Painted Grey Ware, NBP = Northern Black Polished Ware, EHis = Early Historic, Med = Medieval. Where sites have been recorded previously, the publication is noted.

RHS No.	Local name	RHS Site name	Village	East Deg.	East Mins.	North Deg.	North Mins.	Elev. asl	EHar	MHar	LHar	PGW	NBP	EHis	Med	Previous reporting
1	Karsana /	Chanaut I	Chanaut	75	55.979	29	11.953	208	1							Possehl 1999
2	Sabbar wala khera	Chanaut II	Chanaut	75	55.522	29	11.834	208	1	1	1					Possehl 1999
3	No name	Chanaut III	Chanaut	75	56.339	29	12.302	206	1	1		1		1		Possehl 1999
4	No name	Singhwa Ragho I	Singhwa	75	56.048	29	14.381	205						1		Possehl 1999; Kumar
5	No name	Singhwa Ragho II	Singhwa	75	55.333	29	13.961	207						1		Possehl 1999; Kumar
6	No name	Sindhar	Sindhar	75	15.66	29	15.782	216						1		-
7	No name	Khanpur	Khanpur	75	56.555	29	16.7	207			1					Possehl 1999; Kumar
8	No name	Gurana	Gurana	75	56.807	29	17.541	213	1							-
9	No name	Dhad I	Dhad	75	59.261	29	18.947	218						1		-
10	No name	Dhad II	Dhad	75	59.43	29	19.364	217						1		-
11	No name	Badhawar	Badhawar	75	57.677	29	20.224	224								-
12	Data Goshala	Data I	Data	76	1.185	29	13.325	208						1		Kumar 2009
13	Sala Dheri	Data II/MSD X	Data	76	0.46	29	13.682	209	1	?	?	?			--	-
14	Theruwa/	Data III/MSD IX	Data	76	0.464	29	14.27	212						1		-
15	No name	Data IV	Data	76	1.223	29	15.296	203	1	1	1			1		-
16	No name	Data V	Data	76	1.499	29	14.486	210		1				1		-
17	No name	Kharak I	Kharak	76	0.861	29	21.482	224						1	1	Possehl 1999; Kumar
18	No name	Kharak II	Kharak	76	0.787	29	21.209	214						1		Possehl 1999; Kumar
19	Pathanwala	Serhera I	Serhera	75	58.279	29	22.989	205	1		1			1		-
20	No name	Serhera II	Serhera	75	57.838	29	23.482	217			1					-
21	No name	Serhera III	Serhera	75	58.009	29	23.628	207						1		-
22	No name	Serhera IV	Serhera	75	57.931	29	23.931	210								-
23	Chandukheri	Madloda I	Madloda	75	58.827	29	24.472	213			1			1		-
24	No name	Madloda II	Madloda	76	0.582	29	23.965	194						1		-
25	No name	Kumbhakhera	Kumbhakhera	76	0.232	29	26.361	223		1	1					-
26	Batheri	Banbhori I	Banbhori	76	1.781	29	25.271	221	1		1					-
27	Gujjarchhala Khera	Banbhori II	Banbhori	76	2.284	29	23.95	215						1		-
28	Kharkhari	Chhan	Chhan	76	3.379	29	25.209	212						1		-
29	Shyam Mandir	Sandlana	Sandlana	76	4.019	29	25.25	217							1	-
30	No name	Makhand	Makhand	76	5.848	29	25.592	227						1	1	Chakrabarti and Saini
31	No name	Boraian	Boraian	76	7.847	29	25.317	230							1	-
32	No name	Bhongra	Bhongra	76	8.902	29	27.005	220	1			1	1			Chakrabarti and Saini
33	Shed(r)i Khera	Baroda	Baroda	76	11.257	29	24.814	224						1		Possehl 1999; Kumar

RHS No.	Local name	RHS Site name	Village	East Deg.	Mins.	North Deg.	Mins.	Elev. asl	EHar	MHar	LHar	PGW	NBP	EHis	Med	Previous reporting
34	No name	Biyana	Bryana	76	1.955	29	18.774	199						1		Possehl 1999
35	No name	Sarsana	Sarsana	76	1.19	29	21.481	217							1	-
36	Diddarpur Khera	Panhuan	Panhuan	76	3.525	29	21.134	223						1		-
37	No name	Sotha	Sotha	76	4.623	29	22.574	213						1		-
38	Gandash Khera	Kapra I	Kapra	76	7.552	29	21.756	217							1	-
39	No name	Kapra II	Kapra	76	6.905	29	23.061	214						1		-
40	Redithal	Koth Kalan	Koth Kalan	76	9.257	29	22.142	220						1		-
41	Nai wala Khera	Barsola I	Barsola	76	13.112	29	22.969	225						1		Chakrabarti and Saini
42	Noi wali Thali	Barsola II	Barsola	76	13.386	29	21.825	208						1		-
43	Goth Khera	Khatkar	Khatkar	76	15.646	29	24.652	206							1	Possehl 1999; Kumar
44	No name	Kheri Jajwan	Kheri Jajwan	76	13.15	29	20.543	216						1		-
45	No name	Sangatpura	Sangatpura	76	14.525	29	19.934	220			1					Possehl 1999; Kumar
46	No name	Intal Kalan	Intal Kalan	76	15.265	29	18.487	221				1	1	1		-
47	No name	Lohari Ragho I	Lohari Ragho	76	2.084	29	14.796	212	1	1	1					Possehl 1999; Kumar
48	No name	Lohari Ragho II	Lohari Ragho	76	4.25	29	16.493	207	1	1						Possehl 1999;;Kumar
49	Gujjar Khera	Haibatpur	Haibatpur	76	4.386	29	18.294	217						1		-
50	Dedonwah	Mirchpur I	Mirchpur	76	10.467	29	19.33	212						1		Kumar 2009; Chakrabarti
51	Bida Khera	Mirchpur II	Mirchpur	76	11.032	29	19.356	213						1	1	Kumar 2009, Chakrabarti
52	Dhoh Mandhi Wala	Mirchpur III	Mirchpur	76	11.34	29	19.767	212			1			1		Kumar 2009; Chakrabarti
53	No name	Mirchpur IV	Mirchpur	76	10.325	29	18.218	216			1			1		Kumar 2009; Chakrabarti
54	Laddenpatti Wala	Mirchpur V	Mirchpur	76	9.64	29	17.691	217						1		-
55	Jaganwala Khera	Mirchpur VI	Mirchpur	76	8.922	29	18.278	214	1		1			1		-
56	No name	Ramran I	Ramran	76	14.196	29	16.839	215							1	-
57	No name	Ramran II	Ramran	76	14.408	29	16.644	203				1		1		-
58	Punpun Wala Khera	Ramrad III	Ramrad	76	15.418	29	15.959	207						1		-
59	Chhanjjanwala Khera	Gulkah	Gulkah	76	11.418	29	17.044	213	1							-
60	No name	Baganwala	Baganwala	76	12.834	29	15.839	209						1		Chakrabarti and Saini
61	No name	Milakpur I	Milakpur	76	10.277	29	16.711	214			1					-
62	Thah	Milakpur II	Milakpur	76	9.928	29	16.915	215							1	-
63	No name	Milakpur III	Milakpur	76	9.591	29	17.208	213						1		-
64	No name	Budana	Budana	76	7.307	29	15.723	203						1		-
65	No name	Igra	Igra	76	14.778	29	13.505	229			1	1		1		Chakrabarti and Saini
66	No name	Kagsar	Kagsar	76	12.876	29	14.219	215				1	1			-
67	Denthal	Khandakheri I	Khandakheri	76	12.682	29	13.041	211						1	1	Chakrabarti and Saini
68	No name	Khandakheri II	Khandakheri	76	12.854	29	11.471	200							1	Chakrabarti and Saini

RHS No.	Local name	RHS Site name	Village	East Deg.	Mins.	North Deg.	Mins.	Elev. asl	KHar	MHar	LHar	PGW	NBP	KHis	Med	Previous reporting
69	No name	Khandakheri III	Khandakheri	76	12 095	29	11 856	210			1	1	1			Possehl 1999
70	Saiyad wala khera	Sulchani I	Sulchani	76	11 013	29	13 172	213						1		Possehl 1999; Kumar
71	Chandu wala khera	Sulchani II	Sulchani	76	11 225	29	13 299	213						1		-
72	No name	Sulchani III	Sulchani	76	11 488	29	12 745	221						1		-
73	No name	Narnaund	Narnaund	76	9 35	29	12.607	211				1				Possehl 1999
74	Satrol khera	Madha	Madha/Rajpur/	76	4.65	29	10.768	210				1		1		Kumar 2009
75	No name	Rajpura	Rajpura	76	3.342	29	10 876	209	1							Possehl 1999, Kumar
76	Jhaurwala khera	Pali	Pali	76	3.802	29	9.953	219			1	1		1		-
77	Saiyad wala Khera	Kumbha I	Kumbha	76	3.945	29	7.717	214							1	-
78	No name	Kumbha II	Kumbha	76	5.248	29	8 254	210						1		-
79	No name	Kumbha III	Kumbha	76	5.32	29	7 961	220						1		-
80	No name	Petwad I	Petwad	76	9.58	29	10.183	212							1	-
81	No name	Petwad II	Petwad	76	10.241	29	10.672	210				1				-
82	Kheri Maggi	Petwad III	Petwad	76	11 881	29	9.179	211				1	1			-
83	No name	Petwad IV	Petwad	76	9 217	29	8.979	219				1	1	1		-
84	No name	Majra I	Majra	76	6.819	29	10.822	213			1			1		Chakrabarti and Saini
85	No name	Majra II	Majra	76	6.47	29	11.083	210			1	1				Possehl 1999; Kumar
86	No name	Moth Rangharan	Moth	76	5.639	29	14.026	205						1		-
87	No name	Thurana I	Thurana	76	6.738	29	8.574	206			1	1				Possehl 1999, Kumar
88	Kajal Khera	Sisai I	Sisai	76	2 832	29	12.02	214						1	1	Possehl 1999, Kumar
89	Pillu Khera	Sisai II	Sisai	76	3.661	29	12 115	221			1			1		Possehl 1999, Kumar
90	Gadda Khera	Sisai III	Sisai	76	1.225	29	12.231	213			1					Possehl 1999; Kumar
91	Khera Rangharan	Ugalan	Ugalan	76	15.94	29	9.37	222				1		1	1	-
92	No name	Dharam Kheri	Dharam Kheri	76	16 239	29	11.936	215			1	1		1		Possehl 1999; Kumar
93	No name	Bibipur	Bibipur	76	16.289	29	15.462	211						1		-
94	No name	Ghimana I	Ghimana	76	17.618	29	15 848	215			1	1				Possehl 1999; Kumar
95	No name	Ghimana II	Ghimana	76	18.207	29	16.494	218						1		Chakrabarti and Saini
96	No name	Ghimana III	Ghimana	76	18.673	29	15 653	223	1	1	1					Chakrabarti and Saini
97	No name	Ramrai Khera	Ramrai Khera	76	15.723	29	16 396	219	1					1		-
98	Burj (Batha Khera)	Bir Bara Ban I	Bir Bara Ban	76	15 721	29	16 396	213						1		-
99	Ratha Khera	Bir Bara Ban II	Bir Bara Ban	76	16.426	29	17.425	214	1	1	1				1	-
100	No name	Loco Colony	Jind	76	17 031	29	19.734	220	1	1				1	1	-
101	No name	Julani	Julani	76	15.792	29	20.642	217							1	Possehl 1999, Kumar
102	No name	Jalalpur Kalan	Jalalpur Kalan	76	15.757	29	19.602	224						1		-
103	No name	Ikas I	Ikas	76	16 4	29	18 475	215	1						1	-

RHS No.	Local name	RHS Site name	Village	East Deg.	Mins.	North Deg.	Mins.	Elev. asl	EHar	MHar	LHar	PGW	NBP	EHis	Med	Previous reporting
104	No name	Ikas II	Ikas	76	15.989	29	18.255	219						1		-
105	Gamri	Mahjat I	Mahjat	75	57.139	29	11 685	208						1	1	-
106	No name	Mahjat II	Mahjat	75	57.172	29	10 942	209						1		-
107	No name	Mahjat III	Mahjat	75	57.962	29	11 238	213						1		-
108	Dhaka wala Khera	Mahjat IV	Mahjat	75	58.373	29	11.936	218			1			1		-
109	Bhunwala Joda	Masudpur VII	Masudpur	75	57.09	29	12.445	208	1	1	1					Possehl 1999
110	Thali /	Masudpur VI	Masudpur	75	57 558	29	12 982	218						1		Possehl 1999
111	Mamanwala	Masudpur V	Masudpur	75	59 179	29	12.603	208	1					1		Possehl 1999
112	Sunarwala Khera	Masudpur II	Masudpur	75	59 027	29	14.577	212			1			1		Possehl 1999
113	Nighana	Masudpur III	Masudpur	75	59.144	29	13.832	208	1							Possehl 1999
114	Malapewala Khera	Masudpur VIII	Masudpur	75	59.71	29	12.444	216			1					Possehl 1999
115	Dholawala Khera	Masudpur XI	Masudpur	75	57.566	29	14 461	210						1		-
116	Sampolia Khera	Masudpur I	Masudpur	75	59.611	29	14 636	213		1	1					Kumar 2009
117	No name	Sisai IV	Sisai	75	59.208	29	12.015	210	1					1		-
118	Dhanuswala Khera	Sisai V	Sisai	75	59.117	29	10.53	209	1						1	-
119	Kheri	Thurana II	Thurana	76	6.267	29	8 097	212						1	1	Possehl 1999; Kumar
120	No name	Thurana III	Thurana	76	7.821	29	8 198	212						1	1	-
121	Saiyad wala khera	Sisai VI	Sisai	75	58.397	29	10.766	209	1					1	1	-
122	Roda Khera	Gamra I	Gamra	76	5 398	29	16.816	208	1	1	1			1	1	Possehl 1999, Chakrabarti
123	No name	Gamra II	Gamra	76	4.521	29	16.721	208	1							Chakrabarti and Saini
124	Rakhigarhi Md 2	Rakhigarhi 2	Rakhigarhi	76	6.679	29	17 437	220	–	1	–	–	–	–	–	Possehl 1999, Kumar
	Rakhigarhi Md 4	Rakhigarhi 4	Rakhigarhi	76	6.724	29	17 36	219	–	1	–	–	–	–	–	Possehl 1999, Kumar
	Rakhigarhi Md 3	Rakhigarhi 3	Rakhigarhi	76	6.757	29	17.497	219	–	1	–	–	–	–	–	Possehl 1999; Kumar
	Rakhigarhi Md 1	Rakhigarhi 1	Rakhigarhi	76	6 829	29	17.621	211	1	1	–	–	–	–	–	Possehl 1999; Kumar
	Rakhigarhi Md 6	Rakhigarhi 6	Rakhigarhi	76	6.828	29	17.883	211	1	–	–	–	–	–	–	Possehl 1999, Kumar
	Rakhigarhi Md 7	Rakhigarhi 7	Rakhigarhi	76	6.333	29	17.685	216	–	1	–	–	–	–	–	Possehl 1999, Kumar
	Rakhigarhi Md 5	Rakhigarhi 5	Rakhigarhi	76	7.074	29	17.357	217	–	1	–	–	–	–	–	Possehl 1999, Kumar
125	Abhayramwala Khera	Masudpur IV	Masudpur	75	58.879	29	14 211	208						1		Kumar 2009
126	No name	Masudpur XII	Masudpur	75	58.935	29	14 872	210	1	1	–	–	–	–	–	-
127	No name	Masudpur XIII	Masudpur	75	57 46	29	15 61	211	1	1	–	–	–	–	–	-

enough winter rainfall to grow crops. Ponds are a factor that deserves a great deal of consideration. Today, most modern villages in Haryana have at least one pond, which plays a critical role in the storage of water and also the husbanding of animals, particularly water buffaloes. The antiquity of pond use in this region is poorly understood, and the presence of large numbers of ponds and depressions around Rakhigarhi may well be significant. The variation in the distribution of major sites indicates that proximity to watercourses need not have been the essential criterion for the placement of ancient sites in this region.

If we aim to ultimately gain a more refined understanding of the protohistoric and historic settlement dynamics of northwest India, the inevitable conclusion is that further surveys are required to revise the locations of all of the archaeological sites on the plains. Particular attention needs to be paid to the distribution of sites along the courses of the various channels that are visible on the satellite imagery. Furthermore, a far more systematic approach to survey needs to be instituted. The *Rakhigarhi Hinterland Survey* has shown that large numbers of sites remain to be identified. Until this work is carried out, we will only have a partial picture of proto- and Early Historic settlement patterns in the region. It should go without saying that all of this must be accompanied by detailed stratigraphic excavation at many sites across the region in order to understand their chronology and their relationships to water resources and the environment (Petrie *et al.* 2009; Singh *et al.* 2009).

By looking at the relationship between the geographical and landscape context and the archaeological evidence for human occupation, existing hypotheses about the impact of changing hydrological systems on the Harappan civilization can be re-examined. It will only be through problem oriented investigations focussing on determining the precise relationship between settlement, water resources and the landscape, that it will be possible to establish how the human populations of northwest India interacted with the land. Only when we understand the full system that operated on the plains of northwest India will it be possible to provide clear answers to questions related to the collapse of Harappan urbanism in this region and the processes involved in the rise of the Early Historic cities.

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Mitathal: New Observations based on Surface Reconnaissance and Geologic Provenance Studies

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Abstract

The Indus Civilization settlement of Mitathal, District Bhiwani, Haryana is rapidly being leveled due to agricultural activities. A short surface reconnaissance was conducted during which, among other things, a steatite seal was recovered. A small fragment of that seal was analyzed using instrumental neutron activation analysis (INAA) and determined to have been made from raw steatite that most probably originated in the Alwar District of northern Rajasthan. This, along with evidence that rock outcrops near the Haryana/Rajasthan border were being exploited for manufacture of grinding stones, indicates that residents of the site had important trade relationships extending towards the south.

Introduction

Mitathal (28° 53' 31" N; 76° 10' 11" E), in the Bhiwani district of southwest Haryana, is an important site for scholars investigating what Possehl (1992) has called the "Eastern Domain" of the Indus, or Harappan, Civilization (Fig. 1). A brief surface reconnaissance was undertaken during a visit to the site by the authors of this paper on 11th March 2007. The geologic provenance of several artefact types, including the first and only steatite seal yet recovered at Mitathal, was also assessed. These new studies have provided a fresh glimpse into this ancient settlement and the surrounding region during the later part of what is commonly termed the Mature Harappan period (ca. 2600-1900 B.C) of the Indus Civilization.

Site Location and Past Research

Mitathal is situated on the alluvial plain near a channel between the Chautang and the Yamuna rivers and is in close proximity (25 to 30 km) to the hilly outcrops of Kaliana and Tosham, which are rich in quartzite and meta-volcanic rocks respectively. The site is approximately 120 km west-northwest of New Delhi, 10 km northeast of Bhiwani – the headquarters of the district of the same name, and 1.5 km northwest of Mitathal village.

Prior to excavation conducted by Kurukshetra University in 1968 under the direction of Suraj Bhan (Bhan 1969, 1975), copper artefacts, Indus-style pottery, beads and faience bangles were discovered at Mitathal. Bhan's excavations, although small in scale, revealed much about the site and the region. Firstly, a pre-Mature Harappan phase related to the Kalibangan I and 'pre-defense' (Kot Diji Phase) at the site of Harappa, which in Haryana has been called the Late Siswal culture, was identified. This was followed by a continuous sequence through a Late Harappan phase. Bhan defined a Period I and Period II – c. 2000-1900 B.C. and c. 1900-1500 B.C., respectively. The classical phase of the Indus Civilization (Mature Harappan) was indicated at the site by the presence of well-planned mud-brick structures, beads of carnelian, faience, steatite and terracotta, toy-cart wheels, wheeled toys, sling balls, discs with tapering ends, marbles and triangular cakes of terracotta as well as stone objects such as balls, hammer stones, saddle querns and mullers, and cubical stone weights. The uppermost level (IIB) was designated the "Mitathal" culture (Late Harappan). Some Siswal/ Kalibangan ceramic traditions survived and important finds from this phase include a celt, a *parasu* and a copper ring. Bhan suggested that Indus culture transformed into the OCP and hinted that the possible genesis of the OCP lay in the Siswal phase (Bhan 1975: 3).

Mitathal's twin mounds were christened as 1 and 2 by Suraj Bhan. He recorded Mound 1 as being 150 x 130 m in area and 5 m in height, while Mound 2 was 300 x 175 m in area and 3 m above the agricultural fields. The two mounds whose northern periphery was demarcated by a modern irrigation canal (the Dang Minor) were 10 m apart.

A Brief Surface Reconnaissance

It was evident, both during our short visit to Mitathal and from an examination of recent Google Earth satellite imagery (ca. December 2005), that large portions of the mounds have been destroyed since the time of Bhan's excavation due to agricultural activities. Mound 1 has been reduced greatly on its south and to a little extent on

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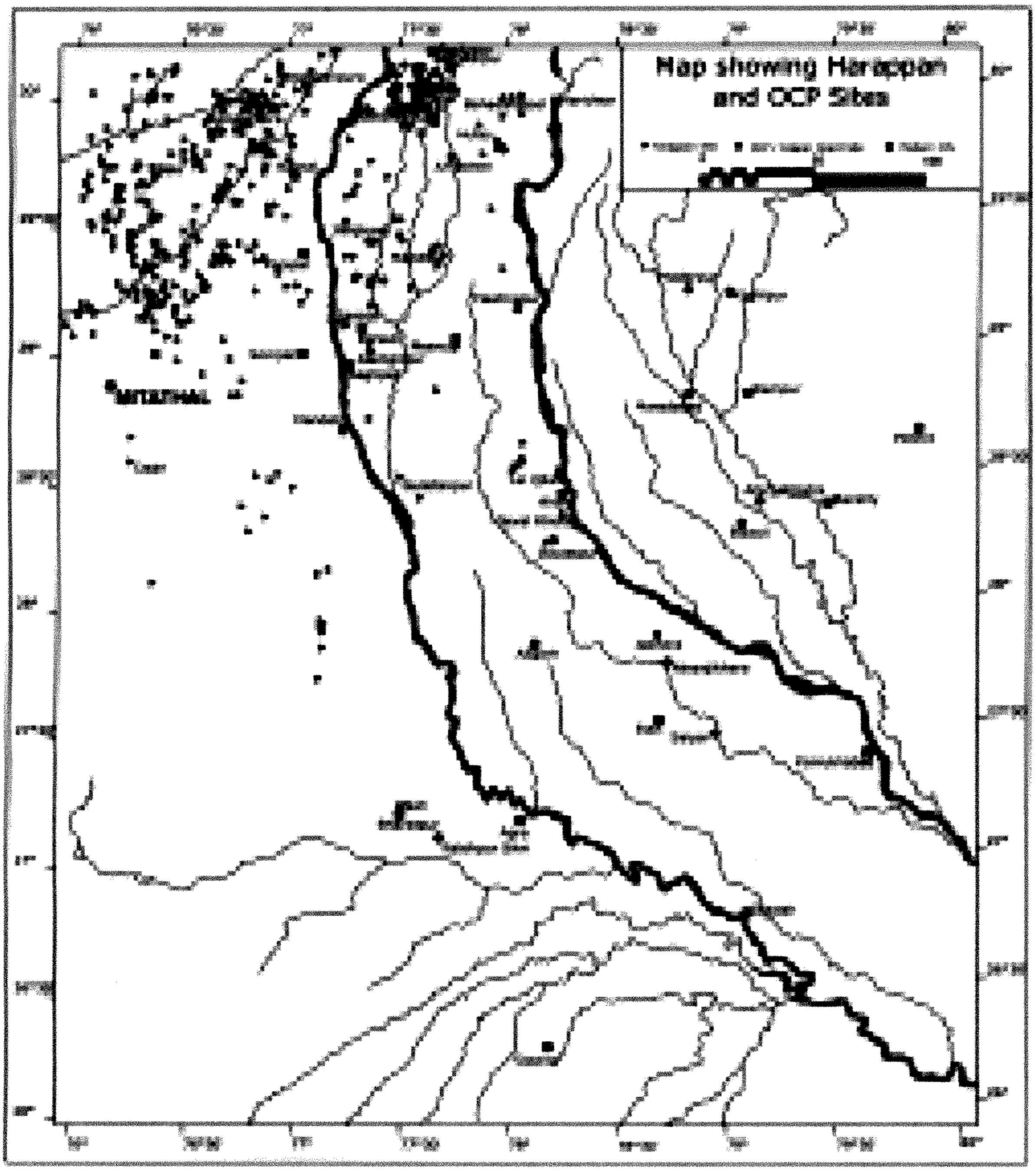

Fig. 1: Location of Mitathal in the "Eastern Domain" of the Indus Civilization.

its north. On the south, the mound was levelled for nearly 40 m and a section of nearly 1 m is exposed. Mound 2 has likewise suffered extensive damage. A huge chunk measuring roughly 50 x 50 m has been lost on its eastern side just in the past few years. Although this ongoing destruction is lamentable, it has provided a wealth of fresh archaeological materials for surface investigation.

When walking across Mitathal one is struck by the large number of blue-green faience bangle fragments visible on the site's surface. Most are so fragmentary that their complete forms are difficult to judge. Nine examples worthy of shape determination are documented in Figure 2. Bangle 1 has a triangular section and is without any decoration, while Bangles 2 and 4 are incised with diagonal lines with triangular and ovular sections respectively. Bangles 5 and 6 have spiked triangular sections and small pinched spike motifs. Bangles 3, 7, 8 and 9 have broadly similar horizontal banding and rectangular sections. If we take these surface decorations into account, parallels are found for Bangle types 2 and 4 in the Harappa Phase

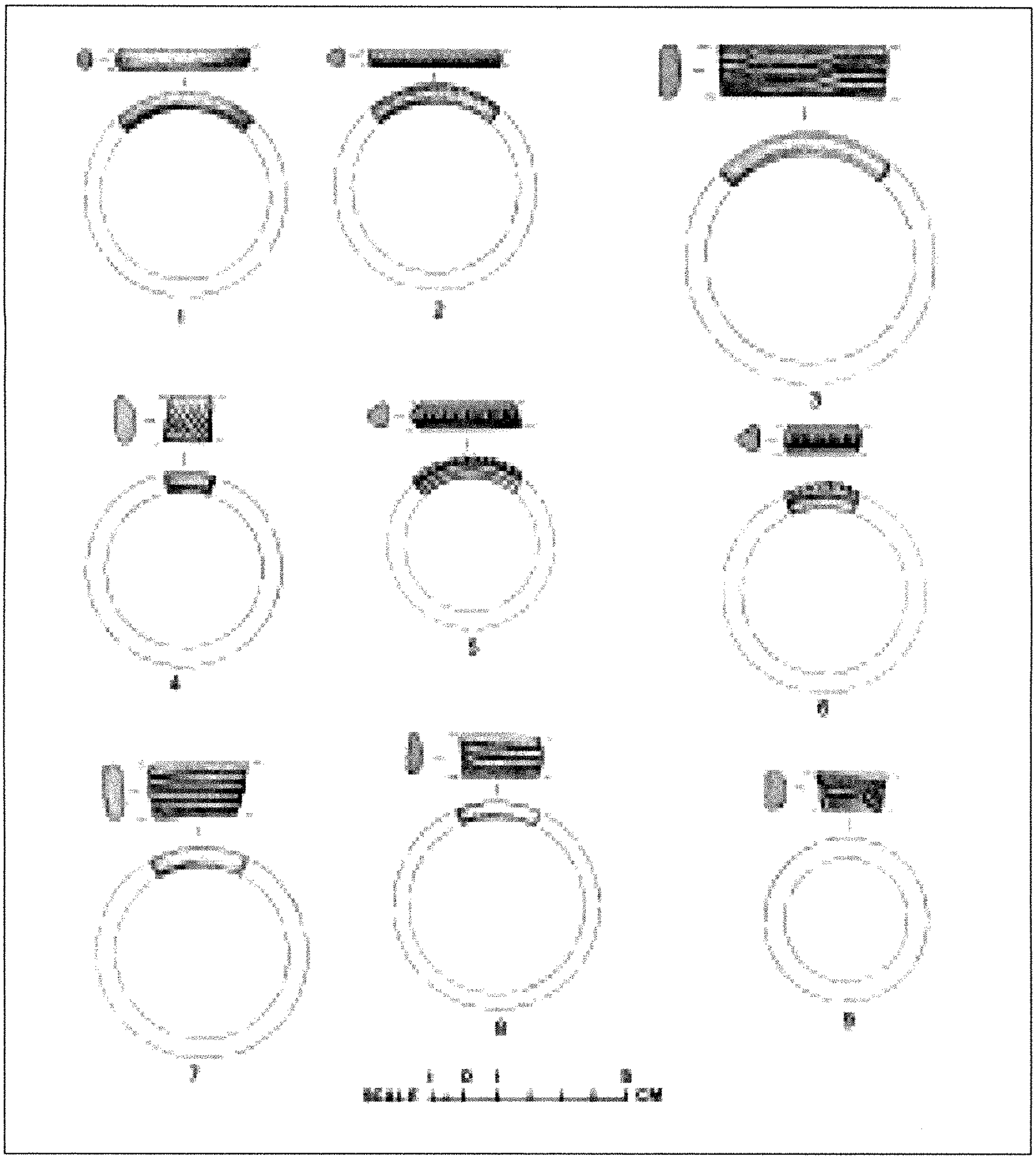

Fig. 2: Select faience bangles collected from the surface of Mitathal.

(Period 3) levels at Harappa (Kenoyer 1992: 87, Fig. 3), while Bangle 5 and 6 have parallels in some terracotta bangles from the same site and period. The horizontal incised designs are not described among the major faience bangle styles from Harappa. Further analysis of faience bangles from Harappa and other Indus Civilization settlements like Mitathal may reveal evolutionary patterns and regional variations, if any.

Ash pits and kilns of considerable size were observed on the northwestern and eastern peripheries of the site. One among these was a feature that is suspected to be a series of faience kilns. The surface evidence indicates an elliptical spread of furnaces in an east-west direction. The furnace walls exhibit vitrification indicative of extremely high temperature craft activities. In his discussion of Indus faience production Kenoyer mentions (1994: 37) the discovery of white rocky quartz at the site of Harappa, which might have been the raw material crushed to make the silica powder. Our exploration of Mitathal also yielded examples of white rocky quartz (Fig. 3). Its presence along with the kilns and the unusually large numbers of faience antiquities (both from the past excavation and from this surface reconnaissance) suggests that Mitathal might have been a major faience production centre.

Other common surface finds were non-diagnostic bits of copper and identifiable copper-alloy objects such as bangle fragments (Fig. 4). Likewise abundant were non-diagnostic fragments (Fig. 5), broken pieces and a few complete examples (see Shinde *et al.* 2008, Fig. 87) of stone querns and mullers. The large majority of these stone

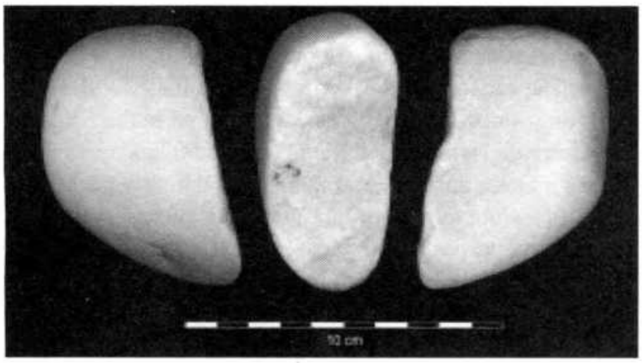

Fig. 3: White quartzite cobble fragment from the leveled surface of Mound 2.

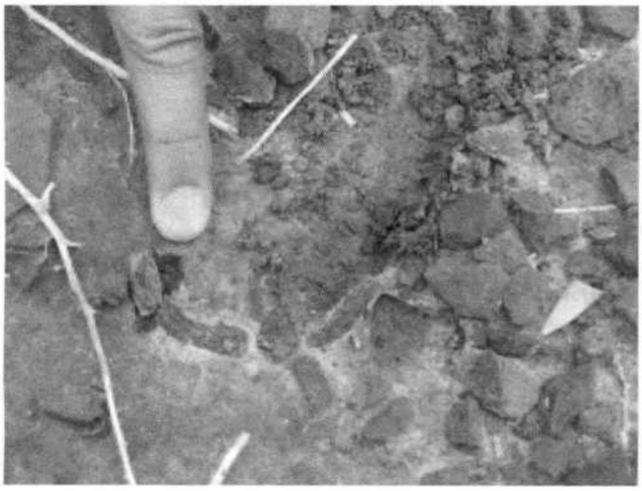

Fig. 4: Copper bangle fragment.

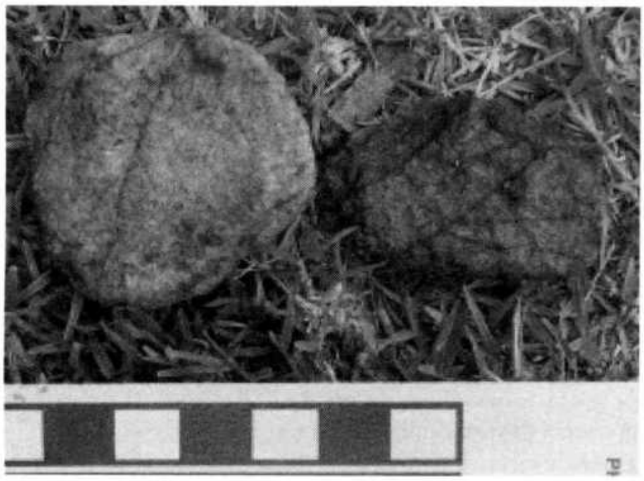

Fig. 5: Reddish quartzite fragments with rife with black seams from the surface of Mound 2.

artefacts were composed of a reddish-coloured quartzite with distinctive thin black seams.

The most significant find by our team was of a broken steatite seal (Fig. 6). It was found on the southern slope of Mound 2 not far from the canal. Suraj Bhan's excavation report makes note of a seal (Bhan 1975: 82, Fig. 16) collected from the surface of Rakhi Shahpur (Rakhigarhi), but no seal or sealing had previously been reported from Mitathal itself. The seal recovered by our team is rectangular in shape, trapezoidal in section and inscribed on one side. The surviving portion measures 15.50 x 14.51 mm. The section of the top and bottom suggests that it was, when complete, convex backed with a perforated hole through the width. Seals of this type were used at the site of Harappa only during Period 3C (Meadow and Kenoyer 2001: 27) and so we can confidently date this surface find to ca. 2100-1900 BC or the later part of what is commonly called the Mature Harappan Phase of the Indus Civilization.

The first sign on the face of the seal resembles a vertical eye enclosing a vertical flaring stroke attached with three short oblique strokes. This sign corresponds to the sign no. 354 in Parpola's "Sign List of Indus Script" (Parpola 1994: 77). The second sign, which corresponds to sign no. 134 in the "Sign List" (Parpola 1994:73), is composed of seven vertical strokes/bars – having four strokes in the first row and three in the second. Scanning electron microscopy (SEM) of the first sign (Fig. 7) was performed at the Department of Materials and Metallurgical Engineering, IIT, Kanpur and suggested that the seal's deeply incised characters were created with a sharp-edged metal tool.

Geologic Provenance Studies

Although our surface reconnaissance was brief, it has nonetheless been possible to assess the geologic provenance of some of the stone artefacts we documented and collected at Mitathal.

Grinding Stone Sources

Co-author Randall Law compiled an extensive database of sources for the grinding stones (querns, mullers, whetstones, etc.) used by Indus Civilization peoples (Law 2008: Chapter 5). The milky white quartzite cobbles we encountered came, in all likelihood, from the foothills of the Himalayas, which are some 200 km to the northwest of Mitathal. Such heavily water-worn cobbles (indicative of a dynamic fluvial environment) are not found in the nearby northern Aravallis. They are, however, quite common in the beds of the major rivers draining the Himalayas such as the Ghaggar, Beas, and Sutlej (R. Law *personal observations*).

The numerous artefacts composed of reddish quartzite with black seams can be traced to a series of small outcrops (Fig. 8) in the vicinity of Kaliana village, some 35 km due south of Mitathal in southern Haryana. This type of stone is actually a variety of Delhi quartzite, which mainly occurs along an extensive zone extending from Northern

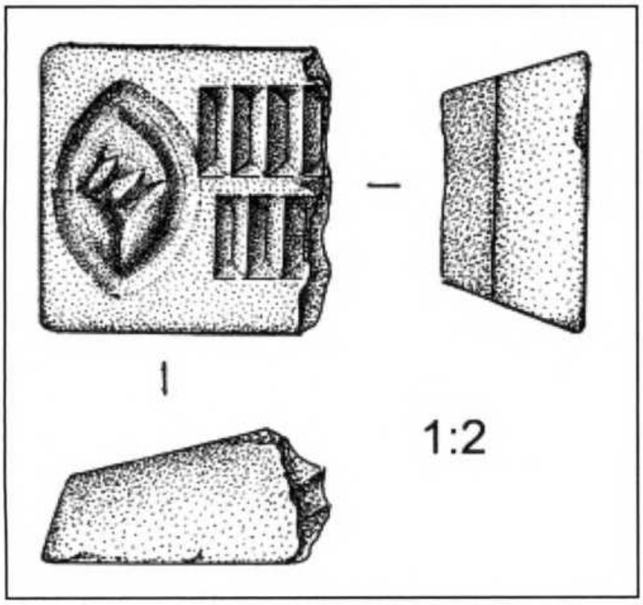

Fig. 6: Drawing of the seal from Mitathal.

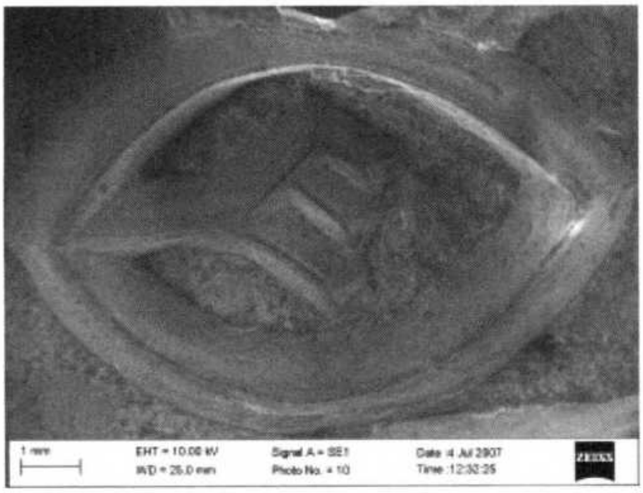

Fig. 7: SEM image of the seal from Mitathal.

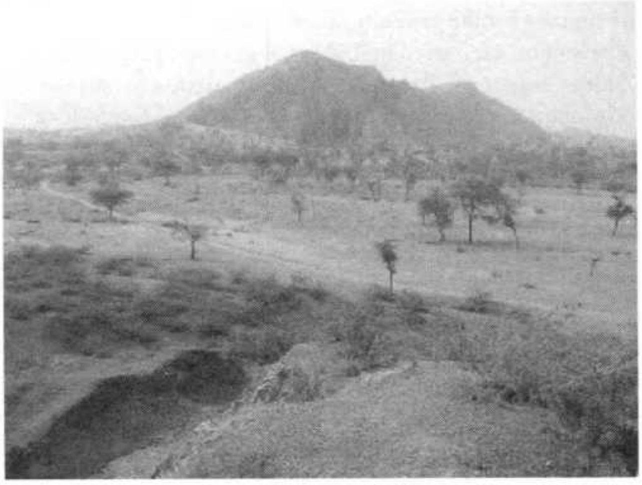

Fig. 8: Delhi quartzite outliers near Kaliana, Bhiwani District, Haryana.

Rajasthan to the city of New Delhi. However, the quartzite along that zone is gray in colour, has a highly silicified, often glassy texture and is generally unsuitable for use as a grinding stone. The Delhi quartzite, found in the Kaliana area outcrops (which are outliers around 50 km west of the main Delhi quartzite formation) has a tightly packed granular texture and is still used to make querns, mullers, mortars and pestles today. Most importantly, only the Delhi quartzite at this location has the highly distinctive appearance – reddish in colour with black seams (Fig. 9) – that is identical to the grinding stone artefacts observed at Mitathal. In fact, it appears that peoples throughout the northern reaches of the Indus realm (Fig. 10) valued the stone from the Kaliana area outcrops. Law has observed grinding stone artefacts from the Kaliana Hills at numerous sites across that region including Siswal, Banawali, and Kalibangan. Over 26% of all grinding stone artefacts recovered from Period 3C levels at the site of Harappa came from this source (Law 2008: 216), which was nearly 400 km away. Ongoing research by Garge and Law on the collections from Rakhigarhi suggests that upwards of 90% of the grinding stones used, derived from the Kaliana source. It is possible that residents of Mitathal, given their relative proximity to that source, were to some degree involved in the exploitation and distribution of raw material from it.

The Mitathal Seal

The rectangular seal discovered at Mitathal was broken at some point prior to its recovery in March of 2007. Whether or not this occurred in antiquity or after it had eroded to the site's surface is unknown. The khaki-colour raw steatite of its unheated interior was visible in the seal's broken section and at numerous places where the "glazed" portion of its exterior was worn away. Some of this unfired material was carefully collected and subjected to instrumental neutron activation analysis (INAA) at the University of Wisconsin's Nuclear Research Reactor.

INAA is a highly accurate and precise method for quantifying the elemental compositions of materials. Archaeologists around the world have long employed it in efforts to determine the provenience of a wide range of artefacts (see Glascock and Neff 2003 for a detailed account of this technique and its application). In brief, INAA involves the irradiation (or activation) of elements within artefacts and/or source samples by exposing them to a neutron flux. Following varying periods of decay, the gamma ray emissions they produce are detected and counted. After the results are screened of elements that failed to be detected in all samples or had high count-rate standard deviations, data can statistically evaluated. The elemental data produced during the analysis of the Mitathal seal are listed in Table 1 in parts per million (ppm). Using canonical distriminant analysis (a multivariate statistical

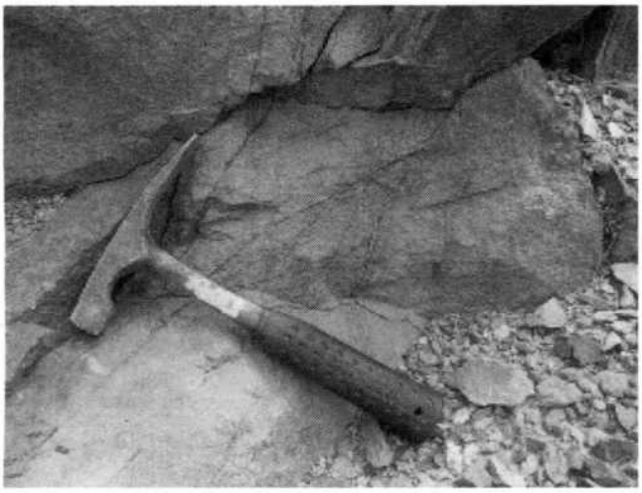

Fig. 9: Detail of Delhi quartzite at Kaliana Hill in situ.

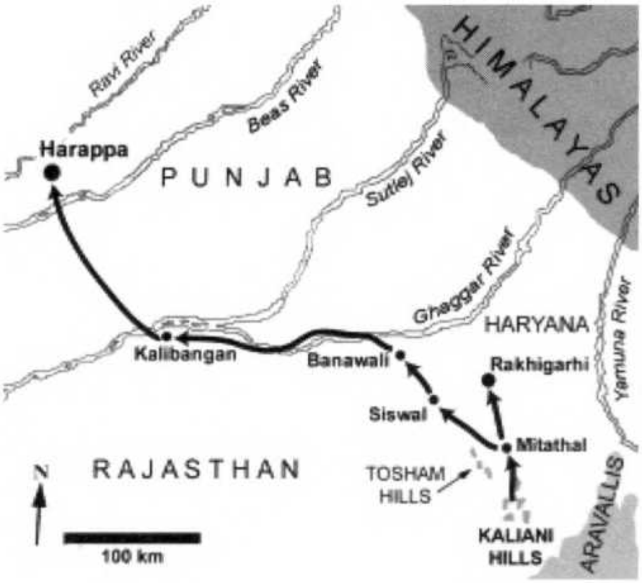

Fig. 10: Possible Harappan Period distribution route for Kiliana quartzite.

technique that is well-suited to differentiating various raw material sources and assigning a possible provenance to artefacts), the elemental composition of the Mitathal seal was compared to INAA-derived geologic data from 37 steatite sources within and adjacent to the area across which peoples of the Indus Civilization dwelled (Law 2008: Chapter 7). The locations of those 37 sources are noted on Fig. 11. The results of the analysis – displayed as a bivariate plot (Fig. 12) – indicate that the steatite the seal is composed of most closely resembles that from a deposit (Nangalhari-Bairaswas) in the Alwar District of northern Rajasthan, some 150 km south of Mitathal.

Table 1: INAA data for the Mitathal seal

Element	*ppm*
Al	2272
Co	2.264
Cr	2.87
Eu	4.018
Fe	1939
La	0.9789
Mn	16.23
Na	1457
Sc	0.0614
V	9.567
Zn	16.13

INAA studies conducted by Law (2008) on samples from the sites of Harappa and Mohenjo-daro indicated that the steatite was largely derived from deposits in the NWFP of Pakistan and the Jammu region of India. It was not surprising to find that the Mitathal seal is composed of steatite from the Alwar District, as that would have been one of the nearest raw material source areas for people dwelling in Haryana. However, a small percentage of the samples analyzed from Harappa and Mohenjo-Daro also appears to have come from Alwar and other northern Rajasthan sources. What we might be seeing at Mitathal then is a node near the beginning of a steatite trade route through which raw material was transported westward towards those distant cities. Hopefully, large-scale analysis of steatite artefacts from major sites like Rakhigarhi can one day be carried out in order to more effectively evaluate the extent to which raw steatite from northern Rajasthan and other source areas was utilized in the "Eastern Domain."

Conclusion

This study highlights the utility of revisiting previously excavated Indus sites even for a reconnaissance as brief as the one described here. The condition of sites that have often not been visited for decades can be re-assessed. The information we gathered on Mitathal's rapid destruction led directly to a short salvage excavation (Shinde et al. 2008: 148-155) by the Indus Project team led by Prof. Vasant Shinde (Deccan College, Pune) and Toshiki Osada (Research Institute for Humanity and Nature, Kyoto). Through the results of that operation as well as the information gathered during our reconnaissance it was possible to confirm much of what Dr. Suraj Bhan reported on the nature of this site over three decades ago, including its apparent role as a major faience manufacturing centre. New material also came to light, however, including the discovery of a steatite seal dating to the later part of the Mature Harappan Period. While all of the evidence indicates that the site was fully integrated into the

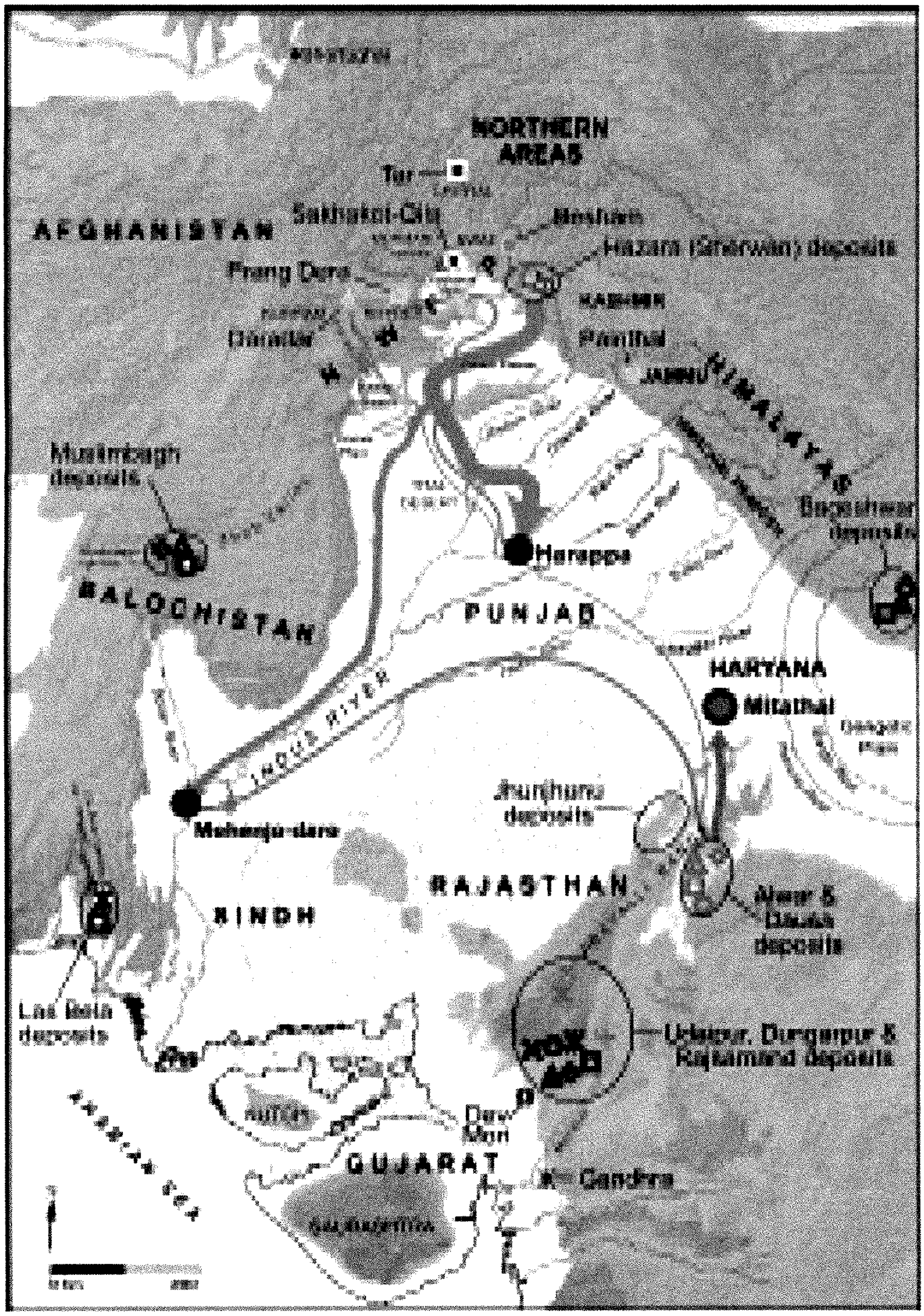

Fig. 11: Steatite sources and select acquisition networks ca. 2200-1900 BC.

interaction system that was the Indus Civilization, geologic provenance studies have revealed that there were important connections toward the south as well. The acquisition of raw material for grinding stones from the Kaliana Hills and steatite from the Alwar region of northern Rajasthan likely put residents of Mitathal in contact with, if only indirectly, peoples of the Ganeshwar-Jodhpur cultural phase. Further evidence for this southern connection may come when the provenance of some of the many copper artefacts recovered from the site is determined.

Acknowledgments

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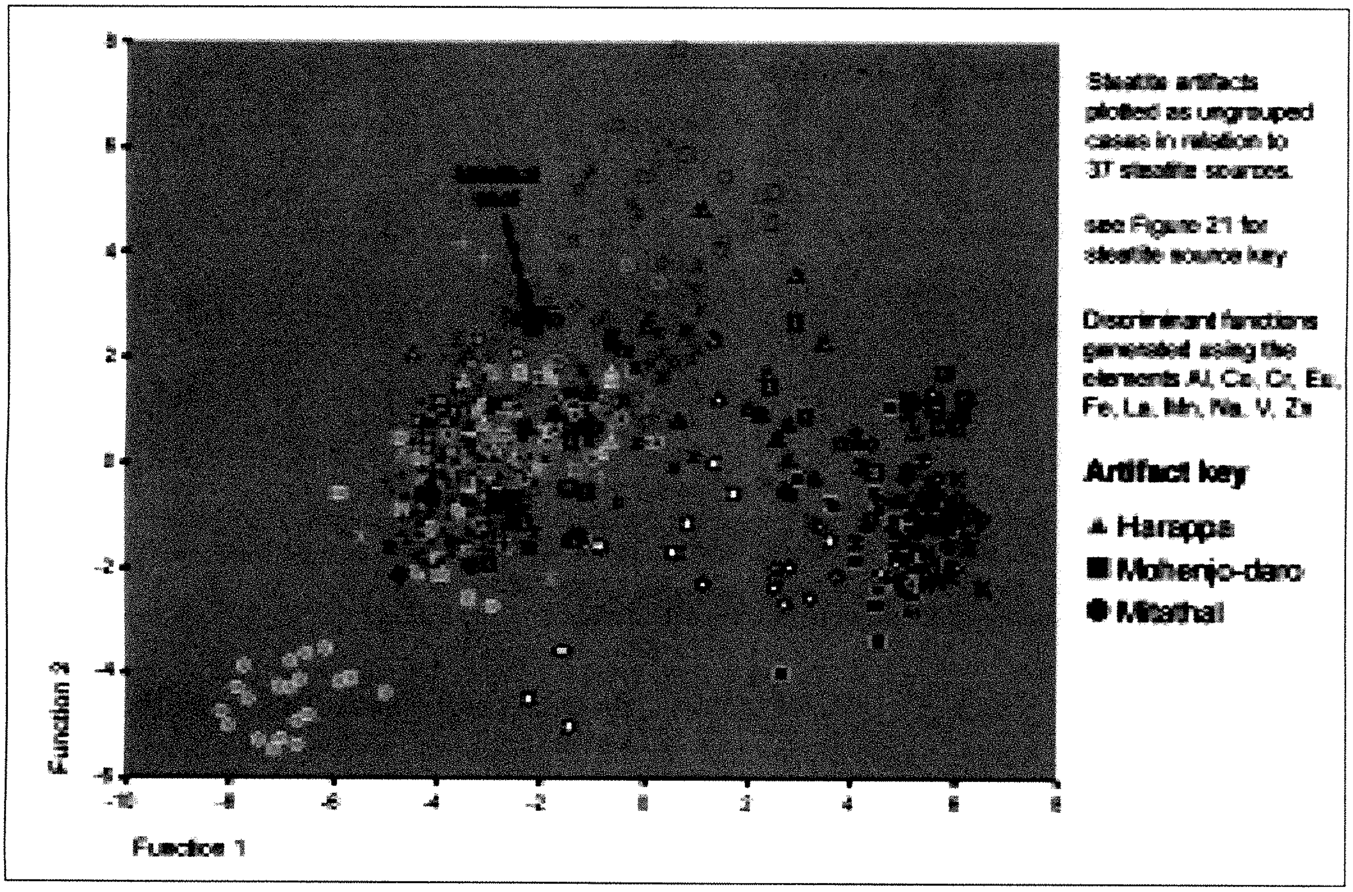

Fig. 12: Bivariate plot comparing Harappan steatite artifacts to samples from 37 geologic sources.

and their team for promptly taking up salvage operations at Mitathal on account of information we provided on the rapid destruction of the site.

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Ecological Continuity: An Explanation for Agricultural Diversity in the Indus Civilization and Beyond

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Abstract

The northwest portion of South Asia was characterized by great ecological and cultural diversity from the prehistoric to the historic era. Soils, climates and moisture patterns that differentiate one region from another remained relatively stable from the time of the Indus Civilization into the colonial period. Ecologically distinct regions were closely associated with specific agricultural strategies that were equally as distinct. The argument put forward in this paper is that we can better understand the agricultural diversity and hence, cultural diversity of northwest South Asia in these periods, by identifying those ecological zones that remained relatively stable over time.

Introduction

The Indus or Harappan Civilization, located in the northwest portion of South Asia, has been extensively studied and appears prominently in the literature as one of the earliest urban civilizations of the ancient world. The urban period, from 2600 to 1900 B.C., includes nearly a thousand sites dispersed in an ecologically diverse environment throughout northwestern India and Pakistan. Models of the agricultural practices of these Harappan communities are based on region-wide environmental conditions that are mainly driven by the seasonal constants of summer monsoons and winter rains. These models, while correct in distinguishing the general moisture patterns, fail to incorporate how local environments and different regional ecosystems determine diverse and distinct agricultural communities. The importance of understanding the impact of local environments on any specific agricultural community is primary in understanding agricultural strategies, responses to climatic shifts, and the development of social systems. While these issues have not gone unnoticed (Possehl 1996; Madella 2003; Miller (unpublished); Madella and Fuller 2006), mega-regional modelling is still the norm. This paper will demonstrate why we need to focus more on micro-regional models and lay out how this might be done.

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The Indus Civilization and the Importance of Agriculture

The socio-political, economic and environmental conditions that prevailed during the Indus Civilization are still hotly debated (Weber 2003: xii). While there may be little consensus as to why this region developed such a civilization, how it evolved, or even why it disappeared, no-one disputes the importance of agriculture in this sequence. Agricultural production of the Indus civilization was based on a long history of food production, incorporating many different groups of people, spread over a very large area.

Geographically, the Indus civilization extends from the Himalayas in the north to the Arabian Sea to the south. This area incorporates the coastal regions from Saurasthra in India westward to the Iranian-Pakistan border. To the west, it is bordered by the Baluchistan mountain ranges and on the east by the Thar Desert and Ganga-Yamuna Doab area. Covering an area of over 1,000,000 km^2, the Indus civilization is one of the largest of its time (Fig. 1). At its height, around 2600 B.C., the civilization had communities containing houses with uniform sized bricks, granaries, large city walls, gateways, and extensive areas of craft production (Kenoyer 1998; Possehl 2002). Craft products were often standardized and distributed throughout the region. The demand for raw materials, food, and finished products meant that a significant amount of interaction was necessary and helped integrate the civilization (Weber 1999:

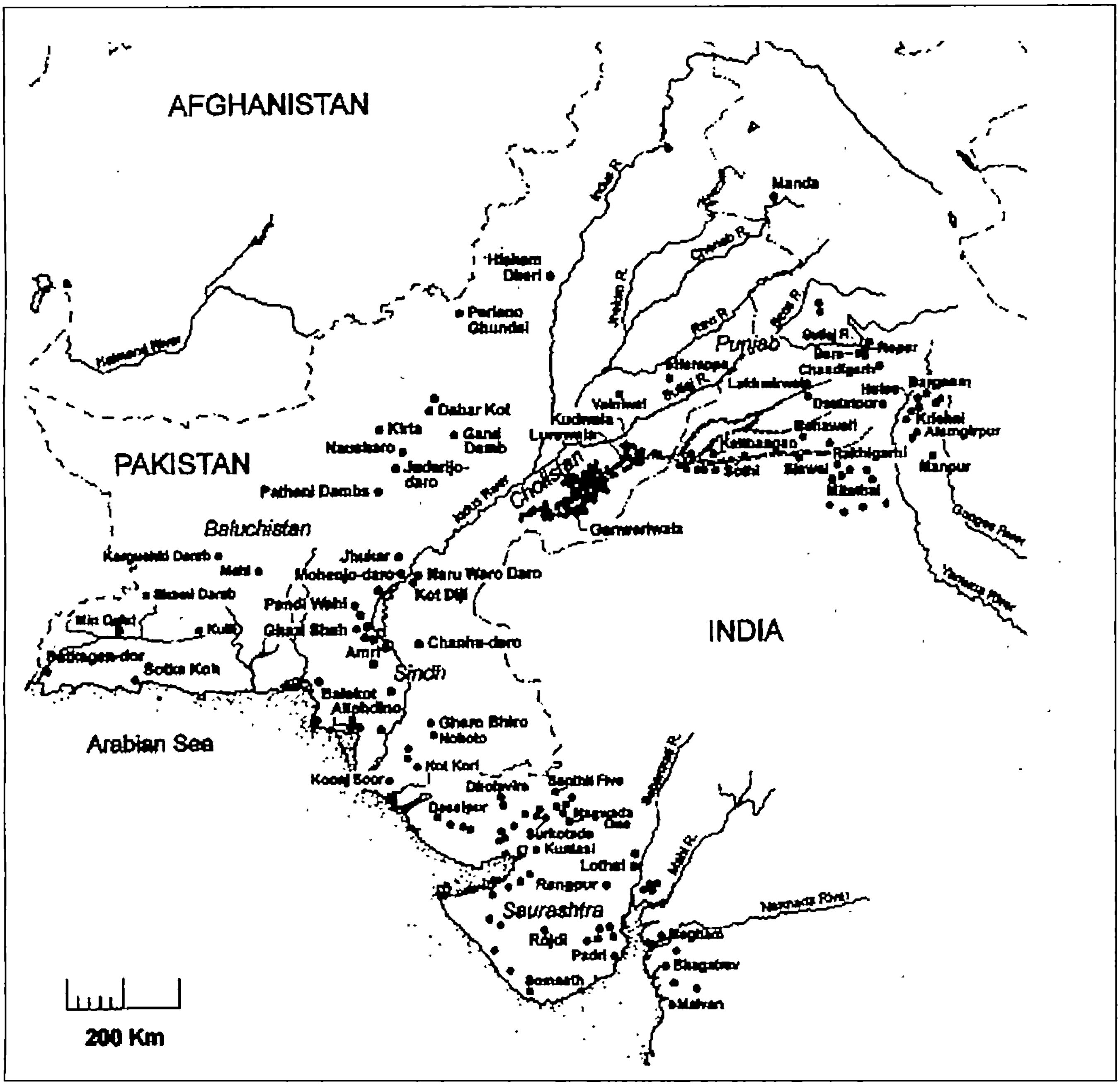


Fig. 1: Map showing Indus civilization sites

813). Common pottery, standardized weights and the widespread use of seals imply a shared ideology and the existence of an administrative system to oversee the manufacture and distribution of goods (Weber 1999; Kenoyer 1998; Possehl 2002). The cultural homogeneity that characterizes the Harappan civilization lasts for nearly 600 years or until around 1900 B.C. At this point, the cultural integration begins to break down and we see a rise in regional systems that were no longer held together by a single ideological or socio-economic system.

The subsistence system consisted of a food producing economy with domesticated plants and animals, some hunting, fishing, and wild plant gathering (Meadow 1996; Weber 1999:813). The Harappan agricultural strategy was based on two main growing seasons. The *rabi* or winter season involves crops sown in the autumn, harvested in the spring and fed with winter rains. Winter crops might include barley, wheat, oats, peas, lentils, chickpea, jujube and mustard. The second cropping season was the *kharif* or summer season which was based on plants sown in the summer and harvested in the fall, making use of the summer rains. Prehistorically, the summer sown plants included a variety of millets, dates, gram, cotton and possibly rice.

Reconstruction of Harappan agricultural practices is primarily based on a limited archaeobotanical record. Although carbonized seeds, leading to subsistence reconstruction, have been recovered from fewer than 50 Harappan sites (Fuller and Madella 2000; Weber 2003; Kajale 1991), extensive models have been developed to explain seed patterning and agricultural strategies (Meadow 1989, 1998; Jarrige 1985; Weber 1999; Fuller 2003). While the majority of these sites contained a variety of grains, implying the use of both summer and winter cropped plants, the emphasis at each site seems to have been on one season over the other. This has in turn led to modeling Harappan agriculture as either a *rabi* or a *kharif* system (Weber 1989, 1999; Meadow 1989, 1996). Harappan sites in Baluchistan, Bannu Basin, Sind, Punjab, Swat, and Kashmir are most often described as a *rabi* based agriculture system while sites in Gujarat and western India are seen as being based on a *kharif* system (Weber 1999). This pattern of dividing regions by agricultural strategy based on their primary cropping season continues through the historic record and into modern times. We will argue that focusing on either winter or summer crops is insufficiently precise, and misses distinct differences between sites that focus on the same cropping season. We can better understand the agricultural diversity, and hence cultural diversity of the Indus civilization by identifying local or micro-ecological zones that remained relatively stable over time.

Agro-ecological Zoning

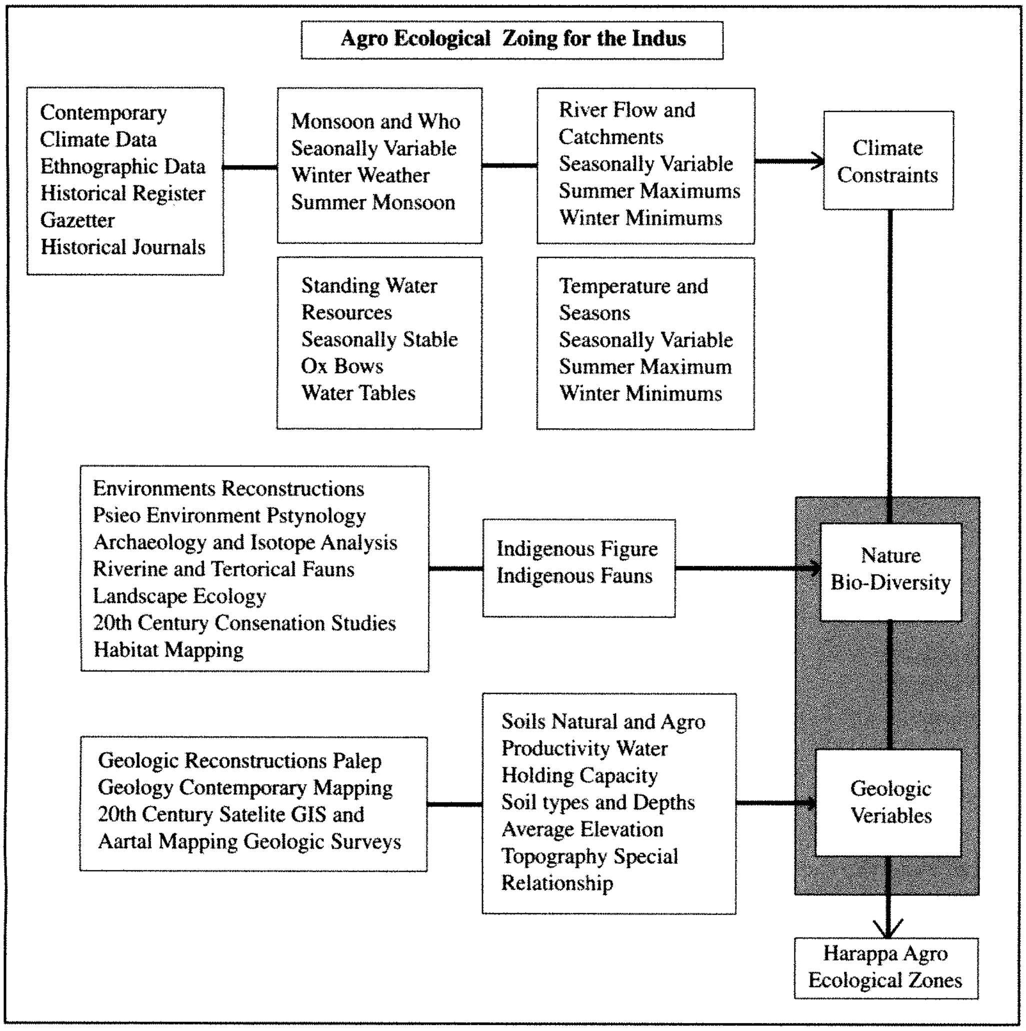
There are different approaches to examining the relationship between subsistence, geography and material culture. In 1989, Gregory Possehl (1992) identified subsistence zones that coincided with stylistic zones of material culture. In this cultural ecological approach, Possehl (1992: 238) constructs a "cultural mosaic" consisting of six distinct Harappan provinces (East Punjab Harappan, Bahawalpur Harappan, Late Kot Dijian, Sindhi Harappan, Kulli Harappan, and Sorath Harappan). In contrast to Possehl's approach to connect subsistence practices with ceramics in an effort to identify Harappan cultural diversity, we believe that we must first identify local ecological zones that impact agriculture and subsistence regimes. Since crop selection, density and distribution are based on a variety of factors including the availability and amount of moisture, temperature, soils and topography, it is important to understand and identify the interactive relationship between these ecological variables and the agricultural responses for all areas of the Indus civilization. This landscape ecology approach (see: Bhan *et al.* 1997; Van West and Kohler 1996), should lead to a better understanding of the relationship between ecological variables, Harappan agricultural practices, and their impact on material culture, population demographics, and habitat loss and degradation.

The Model

The goal of the model, as seen in the flow chart (Figs. 2-3), is to demonstrate how we might identify specific Harappan Agro-ecological zones and then identify the impact these zones have on food production and ultimately Harappan culture. To identify these zones we first need to recognize the climatic and moisture based variables, the range in biodiversity and the geological and topographic variables.

Climatic constraints (Fig. 2) not only influence which crops can be grown but also Harappan agricultural productivity. Such variables as monsoon and wind patterns, rainfall, river flow and catchments, standing water resources, and temperatures, need to be considered. All but standing water resources are highly seasonal, and are differentiated by the variance between winter rains and summer monsoons. Necessary data can be found in contemporary climatic surveys and historical ethnographic data. While neither source can help us quantify the climate for the Indus civilization, it should be able to provide insight into the differences and patterns between the regions, which is the underlining goal of the model.

The second component under review is the natural biodiversity (Fig. 2). Specifically this would include the indigenous fauna and flora. This data is derived from both paleo-environmental reconstructions and also contemporary landscape ecology. Much of the latter has been the focus of conservation studies and habitat mapping. Of final consideration are the geologic variables, including soils, topography (as it relates to spatial relationships) and mean elevations. Much of this information comes from either geologic reconstructions or contemporary


Agro Ecological Zoing for the Indus
Contemporary Climate Data Ethnographic Data Historical Register Gazetter Historical Journals
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Soils Natural and Agro Productivity Water Holding Capacity Soil types and Depths Average Elevation Topography Special Relationship
Geologic Veriables
Harappa Agro Ecological Zones

Fig. 2: Agro-ecological zoning of the Indus Civilization

satellite, GIS and aerial mapping. Once again, while this does not provide exact quantification of the local environments, it does establish patterns for differentiation and review for the region.

With these constraints in mind (Fig. 2), regional responses should be observable in the archaeological record, represented specifically in cultivation practices, animal husbandry, wild plant and animal usage, and water management (Fig. 2). These are in turn entwined with material culture, population demographics, and habitat loss and degradation. These in turn contribute to changes in the flora, fauna, soils and topography. We need to recognize that there is a continuous feedback loop between human induced changes in the landscape and agricultural practices (Figs. 2-3).

Cropping patterns should be recognizable both through the archaeological record and by ethnographic comparison. Contemporary and historical examples are summarized in government reports, ethnographies and journals. An analysis of wild plant cultivation requires paleoenvironmental reconstructions and ethnobotanical analysis such as palynology, phytoliths, and archaeobotanical studies. Research into, and evidence for water management systems for this region should identify sheet flooding, oxbow lakes, redirected waterways, and wells. Some information might be sourced through ethnographic research. Much of it, though, is inferred from careful research into tool technologies and evidence of faunal use in subsistence (for example, use of lake fish versus stream fish).

Materially these constraints should be represented in cooking and storage technologies, food selection, symbolism, and land ownership. At the same time there should be corresponding evidence within the archaeological and ecological record of varying

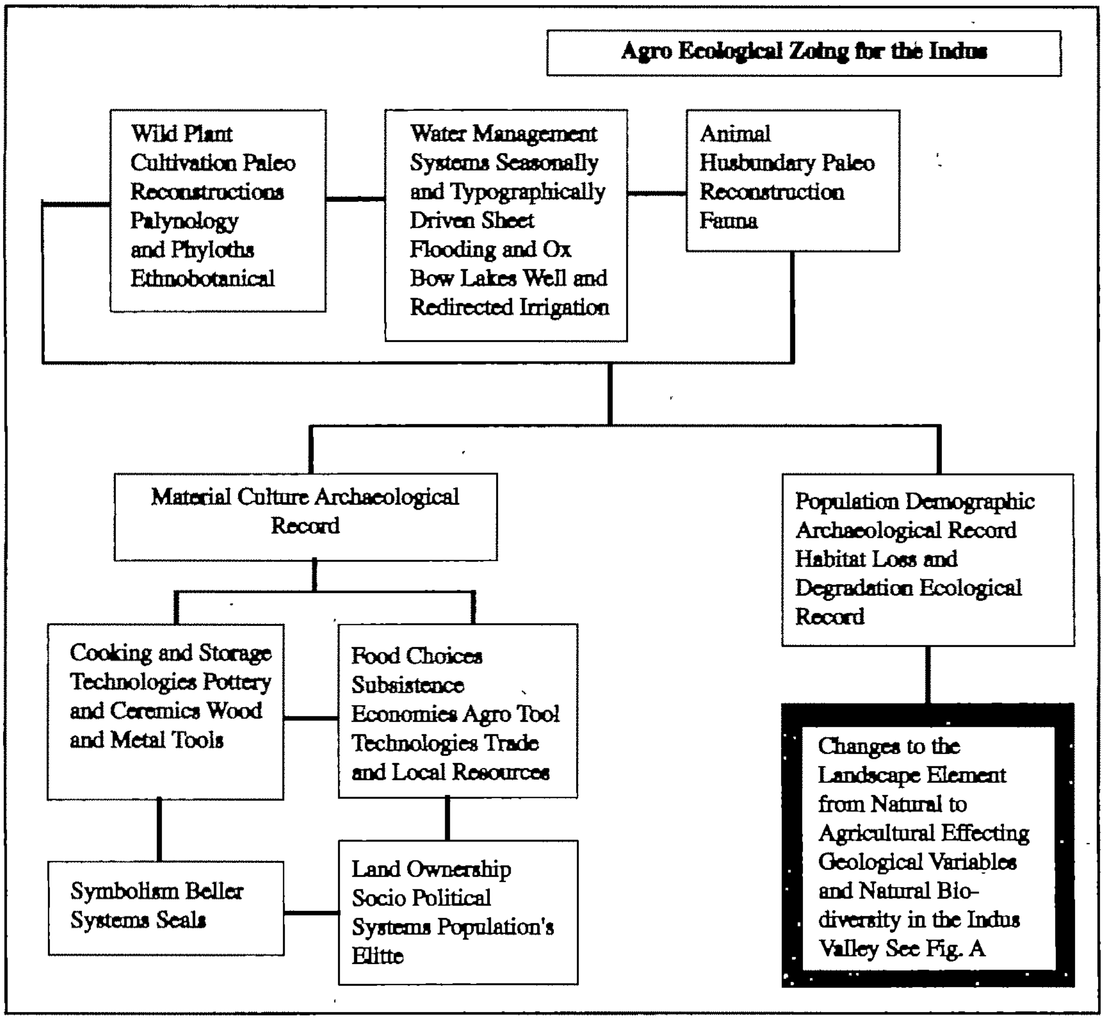
Agro Ecological Zoing for the Indus
Wild Plant Cultivation Paleo Reconstructions Palynology and Phyloths Ethnobotanical
Water Management Systems Seasonally and Typographically Driven Sheet Flooding and Ox Bow Lakes Well and Redirected Irrigation
Animal Husbundary Paleo Reconstruction Fauna
Material Culture Archaeological Record
Population Demographic Archaeological Record Habitat Loss and Degradation Ecological Record
Cooking and Storage Technologies Pottery and Ceremics Wood and Metal Tools
Food Choices Subsistence Economies Agro Tool Technologies Trade and Local Resources
Changes to the Landscape Element from Natural to Agricultural Effecting Geological Variables and Natural Bio-diversity in the Indus Valley See Fig. A
Symbolism Beller Systems Seals
Land Ownership Socio Political Systems Population's Elitte

Fig. 3: Harappan Agro-ecological zones

population demographics and habitat loss and degradation. These three components should provide substantive evidence of divergence in local culture as responding to environmental constraints.

This flow chart is meant to be a tool that can facilitate analysis of regional changes as a response to ecological constraints. The assumption is that this civilization represents a mosaic of ecological niches that would be distinctively accessed by local populations. Each would respond with unique subsistence economies that provided a substantial return on investment. These variances should be recognizable in the archaeological record. Utilizing this tool should allow the researcher to recognize regional variations towards the goal of establishing agro-ecological zones that might impact local communities in distinct ways.

Continuity and Change

Ecological continuity and change in this region over the last 5000 years is difficult to document. Environmental data has been contentious and contradictory (Possehl 2003: 6; Madella 2003:238; Madella and Fuller 2006). The current understanding of the environmental conditions for the Indus Civilization is best described as enigmatic. Environmental inferences and reconstructions are most often based on palynology and sediment studies of the Thar Desert in the Western Rajasthan (Singh *et al.* 1990; Enzel *et al.* 1999; Deotare *et al.* 2004) and studies of coastal Arabian Sea and Himalayan cores (von Rad *et al.* 1999, Phadtare 2000, and Rangarajan *et al.* 2000). Most of these studies suggest that by the third millennium B.C. the climate had shifted from a 1500 year moist cycle into a dry climate pattern more similar to contemporary times. It is also suggested that by the end of the second millennium

B.C., the climate may have further desiccated (Enzel *et al.* 1999; Phadtre 1997; Singh *et al.* 1990; Staubwasser *et al.* 2003). There is growing consensus that changing moisture patterns did impact the Indus civilization and that shifts in rainfall may have been a contributing factor in the rise and decline of Harappan urbanism (Madella and Fuller 2005:16). It should be understood that shifts in the summer monsoons as well as the winter rains are results of large regional systems and not simply part of a local event. All areas of the Indus civilization were impacted by these shifts just as they are today. Local ecologies were certainly not immune to these events, and should not be studied apart from them. At the same time, in the absence of local studies, local environments have been inappropriately extrapolated from both regional studies and the analysis of material remains (Madella 2003: 238).

The basic premise of the agro-ecological zone model is that we can reconstruct the palaeoecology of the Harappan civilization and define zonal variation. Assuming climatic change both occurred, and was regionally constant, and that any local climatic changes were relative to the regional changes, the differential between Harappan sites might be viewed as a constant. That is, while it cannot be assumed that the climate of the Indus civilization represents an exact equivalent to current measures of precipitation and temperature, it might be assumed that there would be a statistical parallel to contemporary trends and seasonal variance. While prehistoric seasonal averages and variances might have fluctuated, the climatic "patterns and differentials" should not dramatically differ with regards to contemporary standards, providing a benchmark for determining site differentials. In other words, there is ecological continuity, in that the zonal ecologies of the past have been relatively stable in comparison to each other. These ecologically distinct zones, past and present, are closely associated with specific agricultural strategies that were equally distinct, identifiable and may impact cultural diversity.

Agro-ecological Zones

Where archaeologists traditionally divide the Harappan civilization into no more than six or seven regions (see: Possehl 1989: 238) and into even fewer agriculturally distinct environments (Weber 1992, 1996), the civilization could easily be subsidized into dozens of distinct agro-ecological zones. If we look at recent efforts to subdivide South Asia into ecologically distinct regions we can begin to see the possibilities of this approach. For example, the Pakistan Agricultural Resource Council (FAO 2004: 3-6) separates Pakistan into 10 Agro-ecological Zones. Each zone has a distinct soil and environmental conditions that directly influence how individuals within the local economies could and would have responded agriculturally. To simplify these zones into fewer, larger regions ignores the extensive environmental diversity of the region.

Studies of the Harappans have tended to focus on large regional trends that look for similarities and uniformity rather than differentiating important variables seen in the archaeological record. This holds true for the ecological variables as well as for subsistence regimes. Current subsistence models for the Indus civilization have been focused on a dual-cropping system that would have taken advantage of the seasonal constants of summer monsoons and/or the winter rains (Weber 1992, 1999; Meadow 1989, 1996). Through this template, agricultural research has been typically driven towards site comparison studies in an effort to identify mega-regional universals that would link them in context with an "Indus Culture Core." While this methodology has provided insight into regional similarities, it has not taken into account local environmental pressures that would have differentiated the micro-regional subsistence models. The use of local agro-ecological zones would identify unique climatic, geologic and riparian pressures that could in turn help distinguish distinct agricultural practices on a micro-level.
It is too early to attempt to subdivide the Indus Civilization into agro-ecological zones; however, to show the value of such an approach, the remaining portion of this paper will look at the available data from three of the most well known Harappan sites, and build a local agro-ecological zone for each. In so doing we can demonstrate the interpretive value of such an approach.

Comparing the Agro-ecological Zones of Harappa, Mohenjo-daro and Lothal

Of the many options for potential agro-ecological zones that may have existed within the borders of the Indus Civilization, we will limit our analysis to three specific regions that contain sites that have been subject to extensive archaeological investigations. Only through comparing the historical and contemporary water resources, soil context, and climatic patterns of the local regions around Harappa, Mohenjo-daro and Lothal, will we begin to understand their respective cropping patterns. Harappa and Mohenjo-daro are generally classified as dependent on the winter crops of wheat and barley, Lothal is seen as based more on the summer crops like millets. What becomes apparent is that all three sites are in ecologically distinct environments and subsequently had very distinct agricultural strategies. Where past studies distinguished differences in their climates (Kenoyer 1998) or in aspects of their cultural remains (Possehl 1992), this analysis focuses on their ecological setting and its potential influence on agricultural production.

At a separation of 5.15° NE-SW and 5.92° NW-SE from Harappa and Lothal respectively, Mohenjo-daro represents the geographic centre for this analysis. This spatial division would be similar to that of Chicago, Memphis and Kansas City. The distinction in these three zones is clearly revealed not by their geographic distance, but rather by the significant differential in their water resources as seen in Table 1. Specifically, at 7-8 cm (three inches) rainfall per annum, Mohenjo-daro receives nearly one-fourth the rainfall of Harappa and only one-tenth that of Lothal. The seasonality of the rainfall patterns is distinct for this region; after the collapse of the winter westerlies come the southwest monsoons during the summer months of June, July, August and September. During this regionally rainy season, the ratio of rainfall between the three zones remains nearly constant with only Lothal showing a marginal increase over time. When the summer months are compared as a percentage of annual rainfall in each zone, Mohenjo-daro shows significantly less variability with the summer months only representing 70 % of its annual rainfall against the winter months at 20%. This is due in part to the overall low amount of rainfall at Mohenjo-daro. Harappa and Lothal show a much greater seasonal deviation at 78 and 95% for the summer and 11 and 2% for the winter, respectively. Thus, while Harappa and Lothal have distinctly moister climates, they also tend to greater seasonal extremes in rainfall patterns.

Comparing contemporary trends to the historic records indicates a great deal of congruity in the variance in rainfall for the region. For example, between the years 1866 and 1883, the average annual rainfall for Sahiwal (Harappa) was 10.3 inches (Gazetteer of the Montgomery District 1884: 15); the average annual rainfall for Larkana (Mohenjo-daro) was 3.28 inches between the years 1896 and 1917 (District Gazetteer of Sindh 1916); and the annual rainfall for Ahmadabad (Lothal) from the years 1877 to 1902 was 29 inches (Imperial Gazetteer 1908: 95). While the differences between these numbers and those today are less than 8%, the variances seem relatively constant. This implies that not only are there are similar trends and variances over the last 150 years, but that there is continuity between these three areas.

While the differential in volume of rainfall for the three zones is staggering, it is important to note that rain is not their only source of water. Each is tied to a riverine network that supports seasonal irrigation to varying degrees (Table 1). For Mohenjo-daro, the Indus river represents a primary water source. Fed by five separate rivers originating in the Himalayan glaciers, as well as the monsoon rains, its catchment is 933, 563 km² (364,700 sq. miles). During the period of 1922 to 1961, an annual average flow of 93 million acre-feet (MAF) was recorded in the northwest at Tarbela, and nearly 154 MAF for the entire river system. Nearly 85% of this water flow occurs during the summer runoff of April 1st to September 30th.

The case of Harappa and the Ravi river is different both with regards to flow and seasonality. The site of Harappa, also built in association with a "subrecent floodplain" (Schuldenrein 2002: 54), has shown similar morphological changes even though the 675 km (422 mile) long Ravi river is maintained by a much smaller catchment of 40,297 km² (15,741 sq. miles). The volume for the river was recorded at 7 MAF between the years 1922 and 1961. Interestingly, only 66 % of the average annual flow of the Ravi occurs during the period of April 1st to September 30th as compared to 85% for the Indus. Once again these figures represent contemporary averages that have been influenced by extensive anthropomorphic changes.

The analysis of the catchment and annual volumes for Lothal's ancient tributary of the modern Bhogavo River presents a more complex challenge. Formerly much closer to the Gulf of Cambay, this paleo-estuary appears to have had its origins in the confluence of a fresh water creek flowing from the northeast and the tidal forces of the nearby bay that

Table 1: Water Resources

	Harappa (Ravi River)	Mohenjo-daro (Indus River)	Lothal (Bhogavo River)
1. Contemporary Annual Rainfall	28.2 cm	7.6 cm	77.2 cm
- Average Winter Rainfall	3 cm	1.5 cm	1.3 cm
- Average Summer Rainfall	22.1 cm	5.3 cm	73.4 cm
- Summer Rainfall, Percentage of Total	78%	70%	95%
- Winter Rainfall, Percentage of Total	11%	20%	2%
- Historical Annual Rainfall	26.2 cm (1886-83)	8.3 cm (1896-1915)	73.7 cm (1877-1902)
2. Average Annual River Flow (1922-61)	7 million acre feet	154 million acre feet	Limited
- Percentage of Flow in Summer	65%	85%	Limited
- River Catchments	15, 741 sq miles	364, 700	Limited
3. Irrigation	Summer Flooding Summer Oxbow Lakes	Summer Sheet Flooding Winter Rains	?

The contemporary climatic variables were compiled through comparing the data from World Climate.org (2005) and Weatherbase.com (2005) for the weather stations at Sahiwal, Sukkur and Ahmadabad, respectively. The Average Annual River Flow was compiled from Pakistan Water Gateway (2005). The Historical Annual Rainfall was compiled through data from their respective Gazetteer (1884; 1908; 1915).

seemed to reach beyond the settlement (Khadkikar *et al.* 2004: 898-899). These resulting dynamics created a shallow but wide water system that bracketed the saltwater marshes on which Lothal was developed (Khadkikar *et al.* 2004: 901). As a result of the turbulent monsoon season and its proximity to the nearby Gulf, it would have been under significant flooding pressures (Khadkikar *et al.* 2004: 902).

In reviewing the context of the three sites, it is important to note that the significant anthropogenic changes that occurred along all the waterways of the Indus Basin since 1890s have dramatically altered the sedimentation and flow patterns, and as such, it is difficult to compare contemporary statistics to prehistoric environments other than to document potential trends (Table 2). For example, the construction of Sukkur Barrage in 1932 and the barrage at Kotri-Hyderabad in 1961 have significantly affected the ecology of the Sindh in that they have lowered the river level (UNESCO 1998: 4), reduced alluvial deposits, tamed the meanderings and seasonal flow variations of the Indus, and raised the local water table. These factors have led to a drastic increase in soil salinity (Allchin 1976:473) and the elimination of several natural riverine flora (UNESCO 1998:4). We also need to take into account that currently of the 154 MAF, about 104.7 MAF is diverted for irrigation, 39.4 MAF flows to the sea and about 9.9 MAF is consumed by the system losses that include evaporation, seepage and spills during floods (Pakistan Water Gateway 2005).

Beyond water resources, the cropping environment for these zones would also have been significantly impacted by soil (Tables 1-2). In this case, three rivers of distinctly different "temperaments" (of which two are derived from similar origins) had direct impact on the soil at these sites. Feeding off its enormous catchments, the Indus river has annually supplied (in a fashion similar to the Nile river) large amounts of alluvial deposits to the Sindh; with 2x1011 kg per year of sediment discharge. Excavations have indicated that since the 3rd millennium B.C. between four to five meters of sediment has been deposited at Mohenjo-daro (Allchin 1976: 473). Prior to its 20 km northern shift some 4000 years ago, the dynamic "fluvial regime" of the significantly smaller Ravi river was also able to provide Harappa with the necessary, and similar, alluvial deposits (Schulderein 2004: 794). For Lothal, the extensive sedimentation appears to have been limited to that provided by a small river system that was surrounded by marshland and alluvial plains in combination with dropping sea levels. This final context is much more difficult to interpret than the former two zones as the soil deposits might not have been in the context of river flooding, but rather from seasonal monsoons (Khadkikar *et al.* 2004: 902).

Table 2: Geology and Landscape. This data was compiled through personal communications with Rita Wright and Richard Meadows (2004), Gazetteer (1884; 1908, 1915), Schuldenrein *et al.* (2005); Belcher (2003), and Khadkikar *et al.* (2004).

	Harappa (Ravi River)	Mohenjo-daro (Indus River)	Lothal (Bhogavo River)
1. **Surrounding Landscape**	Multiple River Systems Separated by Hills, Terraces and Alluvial Plains	Single River System Surrounded by Extensive Alluvial Plain and Desert	Single River System Surrounded by Alluvial Plains
* Description of River	High Bank - Narrow Bed Below Alluvial Plain - Fast Flow	Low Bank - Wide Bed Raised Above Alluvial Plain-Slower	Small Creek Leading To Tidal River of Bhogavo
* Location of City	Terrace Overlooking Plain	Raised Platform On Plain	Adjacent to Creek
2. **Irrigation**	Summer Flooding Summer Oxbow Lakes Summer & Winter Monsoons	Summer Sheet Flooding Winter Rains Hillside Dikes?	???
3. **Anthropogenic Changes** Since 1932	Damning Has: Redirected Water Flow Reduced Seasonal Variations Controlled Annual Flooding Reduced Alluvial Deposits	Damming Has: Reduced River Levels Tamed Meanderings Reduced Seasonal Variations Reduced Alluvial Deposits Increased Ground Salinit	Large Sedimentation Distance to Estuary Increased

This data was compiled through personal communications with Rita Wright and Richard Meadows (2004), Gazetter (1884; 1908, 1915), Schuldenrein *et al.* (2005); Belcher (2003), and Khadkikar *et al.* (2004).

Temperature is an integral component of agriculture production (Table 3). Harappa and Mohenjo-daro have very similar temperature patterns with only a 4% differential in mean annual temperature. The divergence for these two zones comes from Mohenjo-daro having slightly higher seasonal temperatures and less seasonal variation between summer highs and winter lows as compared to annual averages. Harappa, with a slightly more temperate climate, tends to greater seasonal extremes. Lothal on the other hand, shows a significantly higher annual mean temperature, but distinctly less seasonal variation in comparison to the other two zones. The average low winter temperature at Harappa is 128% of the mean for Lothal and Mohenjo Daro, while its average high summer is less than 95 % different.

The ecological context of Harappa, Mohenjo-daro, and Lothal are thus tied to the seasonal flow and sedimentation of three unique, but not always independent rivers (Table 2). Further, each zone represents a continuum of climatic gradients and seasonal variation. Yet similarities in the sites' settlement patterns seem to contradict their ecological differences. Mohenjo-daro was situated on a raised landform some 25 km from the Sindhu Nadi, an area in direct line of river flooding. This situation would have allowed, and possibly encouraged, the use of sheet flooding and other low level technological solutions to irrigation issues (Jansen 1989; Schulderein *et al.* 2004). In comparison, Harappa occupied the protection of a terrace overlooking an abandoned reach of the Ravi that allowed easy access to the fertile soils of the river's floodplain (Schulderein 2002: 71; Wright 2000). Lothal was located in direct contact with the Arabian Sea, and should be considered a marine environment. Today, sedimentation has eliminated the water ingress that separated much of the Kathiawar Peninsula from mainland, but in the past the site was situated on a marshland estuary that was desiccated over time. Knowledge of its irrigations systems and soil patterns are thus limited, but it can be assumed considering the environment that they would have been necessary. Thus, while the former two sites provided easy access to "fresh" alluvial deposits and short-term, standing irrigation, it is expected that the Lothal zone would have required greater efforts by the workforce to capture the summer rains for future distribution during the growing seasons.

Table 3: Temperature Variants

	Harappa (Ravi River)	Mohenjo-daro (Indus River)	Lothal (Bhogavo River)
Contemporary Mean Temperature	23.8 o	25.5 o	27.8 o
Average Temperature in Winter	15 o	17.8 o	22.8 o
Average Low Temperature in Winter	7.2 o	10 o	16.1 o
Average Temperature in Summer	32.2 o	33.3 o	30 o
Average High Temperature in Summer	37.8 o	39.4 o	33.3 o
Average Low Winter Temperature Percentage of Avg. Mean Temp.	60%	64%	74%
Average High Summer Temperature Percentage of Avg. Mean Temp.	133%	132%	112%

The contemporary climatic variables were compiled through comparing the data from WorldClimate.org (2005) and Weatherbase.com (2005) for the weather stations at Sahiwal, Sukkur and Ahmadabad, respectively.

The unique weather patterns and seasonality for Mohenjo-daro and Harappa also would seem to indicate differing water storage technologies and methods at the two sites. While both sites overlook a floodplain, the context and seasonality of the rivers and rainfall patterns does not necessarily lead to identical methods. In the case of Mohenjo-daro, the primary means of water storage and irrigation would have included: sheet flooding of the agricultural plain (Jansen 1989; Possehl 2002: 64; Schulderein *et al.* 2004), the use of *gabarbands* (stone dams) that diverted the water of small streams and torrents into the fields (Possehl 2002: 65), and potentially the brick lined wells that are typically associated with the urban settings, but which in the contemporary context in association with animal labour, are used as storage vessels for small areas of irrigation (Possehl 2002: 104 and Gupta 1985: 378). Excavations have documented 69 wells in the Lower Town of Mohenjo-daro, which supported on average 1,326 m^2 (Possehl 2002: 104).

The site of Harappa differs from Mohenjo-daro in several respects. While it receives significantly greater rainfall, it still is subject to seasonal variations and limitations, and shows signs of water storage and irrigation. These methods include those previously mentioned for Mohenjo-daro: sheet flooding, wells, and *gabarbands*. In addition, the region surrounding Harappa is known for the oxbow lakes that form following the flooding of the Ravi (Gazetteer 1884:5 and Belcher 2003:150). These lakes are excellent storage vessels for both water and fish resources up through the first segment of the dry season. The increased volume and dependability of monsoon rainfall in itself acts as a water storage mechanism for Harappa in comparison to Mohenjo-daro.

Interestingly, none of the three sites had yielded signs of significant irrigational improvements or earthworks. The archaeological record is rather limited to date and has been singular in nature. It would seem that whatever their storage or irrigation technologies or methodologies, in this area of sporadic and limited rainfall they were able to maintain enough water storage to support their agricultural systems. Thus, it is important to think of the Indus, Ravi, the Lothal's paleo-estuary less as "flowing rivers," and more for their ability to supply water sufficient water to the drainage systems for agricultural and domestic purposes.

Based on the description of these three agro-ecological zones, a number of generalizations can be made (see Table 4). First, with distinctly lower precipitation, a slightly higher mean temperature, and less deviation in its seasonal patterns, Mohenjo-daro represents a more "fragile" environment with less climatic variations that thus depends greatly on the Indus for its water needs. The agricultural strategy would have been mostly limited to the winter planted, spring harvested, crops of wheat and barley and would have been more vulnerable to the river and its flow than the other two zones. The archaeobotanical record at Mohenjo-daro is limited and it is therefore difficult to substantiate which other crops may have played a role in their agricultural system. Other crops of significant potential outside of the winter harvest might have been dates and saccharum cane.

Harappa, in comparison, shows greater extremes in seasonal climate, with larger deviations in both precipitation and temperature. A multi-seasonal cropping strategy would help mitigate the extreme seasonality of the water supply and temperatures.

Table 4 : Comparative summary of Harappan agro-ecological zones

	Harappa (Ravi River)	Mohenjo-daro (Indus River)	Ahmadabad-Lothal (Bhogavo River)
1. Contemporary Annual Rainfall	++	+	+++
- Average Winter Rainfall	++	+	+
- Average Summer Rainfall	++	+	+++
- Historical Annual Rainfall (Pre 1915)	++	+	+++
2. Contemporary Mean Temperature	++	++	++
- Average Temperature in Winter	+	++	+++
- Average Low Temperature in Winter	+	++	++
- Average Temperature in Summer	++	++	++
- Average High Temperature in Summer	+++	+++	++
3. Average Annual River Flow (1922-61)	++	+++	+
- Percentage of Flow in	++	+++	n/a
- River Catchments	++	+++	+
4. Surrounding Landscape	Multiple River Systems Separated by Hills, Terraces and Alluvial Plains	Single River System Surrounded by an Extensive Alluvial Plain and Desert	Single Small River System Surrounded by by Marshland and Alluvial Plains
- Description of River	High Bank- Narrow Bed Below Alluvial Plain - Fast Flow	Low Bank- Wide Bed Raised Above Alluvial Plain - Slower	Small Creek Leading To Tidal River of Bhogavo
- Location of City	Terrace Overlooking Plain	Raised Platform On Plain	Adjacent to Creek
5. Irrigation	Summer Flooding	Summer Sheet	Potential Large Scale
Flooding	Flooding		
	Summer Oxbow Lakes	Winter Rains	During Monsoon Season
	Summer& Winter Monsoons	Hillside Dikes?	
6. Anthropogenic Changes Since 1932	Damming Has:	Damming Has:	Large Sedimentation
	Redirected Water Flow	Reduced River Levels	Distance to Estuary Increased
	Reduced Seasonal Variations	Tamed Meanderings	Desiccation of Marshland
	Controlled Annual Flooding	Reduced Seasonal Variations	Extensive Irrigation
	Reduced Alluvial Deposits	Reduced Alluvial Deposits	
		Increased Ground Salinity	
+++ Abundant	++ Sufficient	+ Limited	n/a Unknown

Our understanding of the agro-ecological zone representing Harappa is unique in that we have a very large archaeobotanical database. This data, representing nearly 150,000 carbonized plant remains (see Weber 2003), clearly supports the argument that in a rain and river fed ecology, a much more diverse, and less winter dependent agricultural base would develop. The agricultural strategy at Harappa during the urban period was heavily dependent on both winter (wheat, barley, lentil and peas) and summer (millets) crops. With a wide range of plants being cropped and the winter cereal grains being of primary of importance, the use of summer crops remained an important food supplements throughout the occupation of Harappa. In comparison, Mohenjo-daro which is consistently grouped with Harappa as a winter based system, yet the rather limited archaeobotanical data base shows little crop diversity nor the dependence on summer crops as Harappa. If further carbonized seeds were recovered from Mohenjo-daro it is unlikely that they will include anywhere near the crop range found at Harappa.

With increased summer rainfall, more temperate climates, unreliable riverine water resources, and a distinctly more marine environment, the area of Lothal offers a unique ecological comparison to the other two zones. It is likely that the use of manmade irrigation and storage mechanisms would have been in use to extend the water supply into the winter growing season. Based on the ecological setting of Lothal and the need for a stable agricultural strategy, summer crops were likely the focus. Although the limited archaeobotanical record cannot substantiate this, the large database at the contemporary site of Rojdi might be used to gain insight into Lothal agricultural practices (Weber 1991). At Rojdi, a site also located in Gujarat and in an environment that today is clearly dependent on the summer monsoon rains, both winter and summer crops were prominent in the archaeobotanical record (Weber 1991, 1999). Summer millets were the main cereals, yet barley was present and winter cultigens can be found throughout the site's occupation. Although agricultural production at Lothal was clearly different from what occurred at either Harappa or Mohenjo-daro, it did more closely resemble the large diverse cropping strategy of Harappa than the more limited, river dependent system at Mohenjo-daro.

The Implications of an Agro-ecological Zone Approach

A focus on agro-ecological zones not only forces one to identify the variables that influence as well as limit agricultural production but such an approach exposes the variability of agriculture and the range of potential subsistence strategies within the Indus Civilization. Our preliminary application of this approach, based on the analysis just presented, allows for a number of generalizations or suggestions regarding the Indus civilization (Fig. 6). For example, the subsistence strategies of Mohenjo-daro, with its dependence on the Indus River for its water needs, would have been focused on crops supplying the highest return on investment. To take full advantage of the yields would require augmented irrigation and tool technologies. The limiting potential for summer cropping, and the focus on high yield crops, could also indicate a need to supplement resources through trade. The increased availability of water and distinct seasonality of Harappa is expressed in an increased breadth of domesticates that took advantage of local climatic support and variability. Thus, the archaeobotanical database confirms a large number of taxa harvested in both the winter and summer seasons. Lothal, with its unique temperate climate and temporally limited access to water resources should have made a wider use of a water management system that may have incorporated a multi-cropping strategy.

The archaeological record should confirm both a divergence in secondary crops, summer subsistence strategies, and water storage and irrigation methods for Harappa, Mohenjo-daro, and Lothal in accordance with these patterns. Variations in the material and settlement systems may in turn be better explained once we understand the agricultural strategy at a given site. The cultural distributions identified across the Indus may therefore be a reflection of, or at least influenced by, the local ecology. Not only will this become clearer as we develop agro-ecological zones throughout the Indus civilization, but we may also see greater continuity with historic and modern times.

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Faunal Remains from Jaidak (Pithad), a Sorath Harappan Site in Gujarat

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Abstract

This article reports the results of the analysis conducted on the faunal material unearthed during excavations at Jaidak, a Sorath Harappan site in Gujarat. A single trench (5AC3) was selected as a judgement sample (n = 3885). The analysis revealed a wide spectrum of animal species that includes domestic mammals, wild mammals, reptiles, birds and molluscs. Every bone fragment was carefully examined for any signature of bone modifications to reveal various aspects of taphonomy. It has been noticed that people were involved in skinning, evisceration, dismembering, filleting and fracturing the bones for the extraction of marrow besides using the broken fragments of longer limb bones for bone working.

Introduction

The Harappan site at Jaidak (22° 39.5' N; 70° 34.43' E), locally known as *Jaidak no timbo* is situated about 4 km south of the Pithad village of Jamnagar district, Gujarat. It is situated on the right bank of Aji River, and is surrounded by vast fertile fields (Figs. 1-2). The site was first brought to notice in 1960 during an exploratory survey by a team of archaeologists of the Rajkot Office of the Bombay State Archaeology Department (IAR 1959-60). Bagasara and Kuntasi, both in the Rajkot district, are other important Harappan sites in the region, located about 20 km north and 50 km northeast, respectively (Ajithprasad 2008).

The Department of Archaeology of the M.S. University of Baroda conducted excavations at the site for two seasons (2005-06 and 2006-07). According to excavators, the excavation revealed two distinct phases of Harappan occupation: Period IIA and Period IIB (Personal communication: Dr. Ajithprasad). Period IIA (2200/2100 to 1900 B.C.) is contemporary to the terminal stages of the Mature Harappan, while Period IIB (1900 to 1700 B.C.) revealed assemblage similar to Rojdi C, Kuntasi II and Rangpur IIC. The architectural features exposed during the excavation suggest a classic/urban plan and layout of the Harappan settlement; however, artefacts unearthed during excavation and collected from the surface do not incorporate any classical Harappan traits. The antiquities on the other hand seem to be belonging to the Sorath Harappan as defined by Possehl and Raval (1989).

Identification, Recording and Analytical Methods

The animal skeletal remains collected during the excavation are housed at Baroda. This analysis was done at Baroda during a visit in 2008 with a view to obtain a preliminary picture of animal-based economy at Jaidak. A single trench 5AC3 was selected for this faunal analysis. This trench revealed a cultural deposit of about 2.30 m, which was divided into 8 layers, all belonging to Period IIA. The assemblage related to Period IIB is in form of a surface deposit in this trench. The last two layers (7 and 8) yielded very few skeletal fragments in a very fragmented condition. These, therefore, are not included in the analysis.

Securely identifying a specimen is crucial to archaeozoological interpretations and the most secure approach to identifying species relies on comprehensive skeletal reference. Therefore, comparative reference material housed at the Archaeozoology Laboratory (Deccan College, Pune), and at the Osteology Laboratory, M.S. University Baroda were used to determine the most precise level of identity that could be attributed to a bone. A particular mention of the modern equid (wild ass, domestic ass and domestic horse) reference material available at the Baroda is necessary. In addition, to achieve fine-level identification among closely related species (cattle/buffalo/nilgai and sheep/goat/antelope), help from published literature has been taken, e.g. Joglekar *et al.* (1994), Higham (1975), Gupta *et al.* (1987, 1990), and Prummel and Frisch (1986). Furthermore, the general identification

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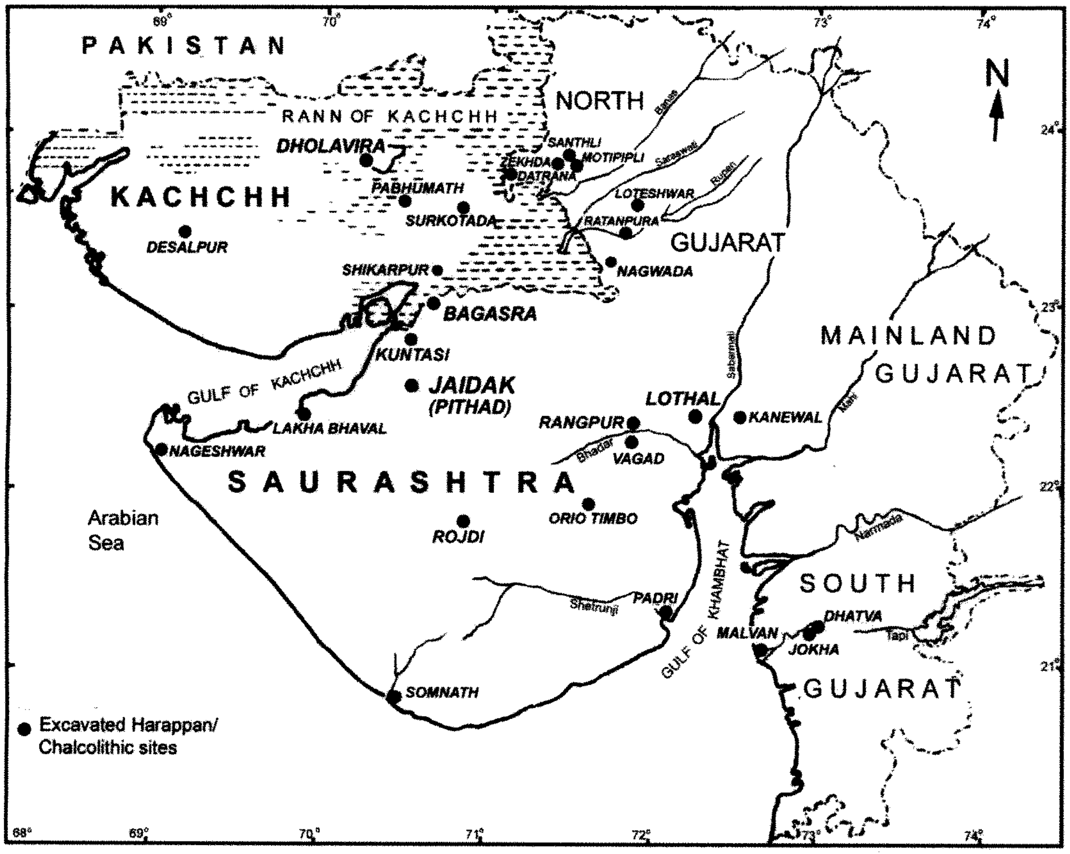

Fig. 1: Jaidak (Pithad) and other important excavated Harappan and Harappan affiliated Chalcolithic sites in Gujarat (Courtesy: M.S. University of Baroda)

keys developed by Schmid (1972), Hillson (1992), Kratochvil (1969) and Miguad (1992) and other scholars were also used while analysing the material. A few categories like *Bos/Bubalus* (cattle/buffalo) and *Capra/Ovis* (goat/sheep) were created wherever it was not possible to differentiate these closely related species. Another category "small mammal" was created to define the bones belonging to the hare-sized mammal but could not be identified up to species level.

The faunal collection from Jaidak comprises of several carnivore species such as the canids (dog and jackal) and felids (panther, domestic cat and jungle cat). Since these species are very similar in their morphological characters, for a secure identification their bones were brought to the Deccan College. Two civets (small Indian civet and Indian palm civet) have also been identified in the assemblage. The palm civet was identified based on its modern reference housed in the Osteology Laboratory, M.S. University, Baroda, while the small Indian civet was identified on the basis of drawings made by Dr. P.K. Thomas in 1970s. These species have not been identified in the other Harappan sites in Gujarat so far and add to the list of identified species in Gujarat.

A standard archaeozoological system of identification, data recording and measuring bones (von den Driesch 1976) was followed. The measurable skeletal fragments and the fragments bearing marks of natural as well as human actions were given unique registration numbers.

The Faunal Material

Out of total 3885 skeletal fragments analysed only 1782 (45.86%) could be identified. A total of 2103 fragments could not be identified. These were termed as unidentified fragments (UF) and recorded as small (<2 cm), medium (2-5 cm) and large (>5 cm) since these can also throw valuable light on the site formation processes. It is clear from the distribution of such unidentified fragments that their occurrence is not uniform in all the layers (Table 1; Fig. 3). Layer 6 revealed the highest number of identified specimens

Table 1 Jaidak: Summary of identification

Layer	NISP	UF				
		Large	Medium	Small	Total	TF
1	727	250	280	552	1082	1809
2	848	251	323	347	921	1769
3	48	2	7	1	10	58
4	65	14	24	26	64	129
5	27	7	5	3	15	42
6	67	5	0	6	11	78
Total	**1782**	**529**	**639**	**935**	**2103**	**3885**

Fig. 2: General view of the mound at Jaidak (Courtesy: M.S. University of Baroda)

(85.9%), while layer 1 exposed the least number of the same (40.19%). The vast majority of the bones included in this study are from secondary contexts that can be identified as accumulated food refuse.

Nature of the Material

Most of the bones in the assemblage were impregnated and encrusted with precipitated mineral salts. However, in general the bones were well preserved. Since a careful look at the bone modifications provides an idea about the way faunal material was discarded/ deposited, every bone fragment was carefully examined for any signature of bone modifications (Fig. 4, see cover page 2). At Jaidak, only in a handful of cases the bone fragments seem to have undergone physical movement and trampling. For example, edges of the proximal portion of the cattle tibia found from layer 1 were rolled. An astragalus of cattle (JK 30) was extremely eroded and showed marks of pitting on the surface probably indicating its displacement within the debris. Some fragments showed the evidence of recent breakage that might have occurred either during excavation or subsequent packing and transportation.

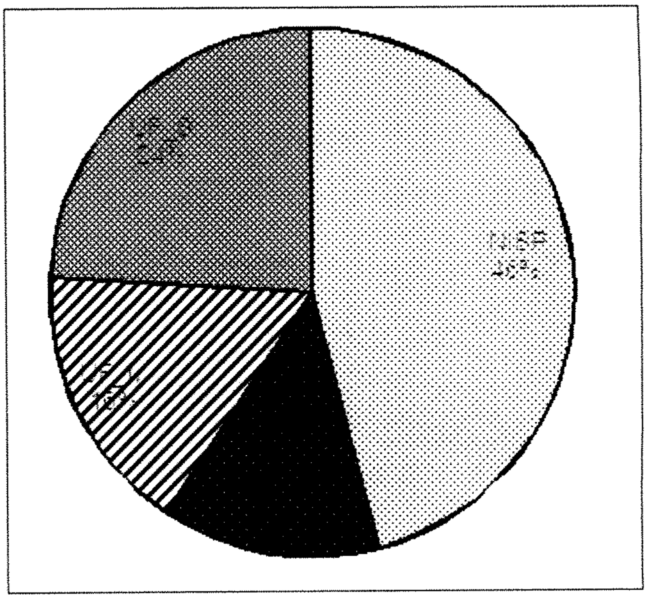

Fig. 3: Relative proportion of unidentified fragments

The patterns of preference, attainment and consumption of animal food by humans are usually supposed to result from logical decision-making, aiming to obtain food in the most profitable manner (Rabinovich and Hovers 2004). The same can be seen at Jaidak. A close look at patterns in cut marks revealed signatures of human activities related to food processing. Three kinds of marks (butchering marks, sawing marks and chopping marks) were observed. The general pattern of bone breakage shows that people not only consumed flesh but also they have extracted internal nutrients from the bone marrow. The activities related to use of animal food were skinning, evisceration, dismembering, filleting and fracturing the bones for the extraction of marrow. The proportion of cut marks was higher in layer 2 (Table 2). It is important to note that several unidentified fragments from the same layer also showed cut marks.

Faunal material from all the layers contained a number of charred bones, which could be categorised into charred (n = 24), completely charred (n = 68) and charred and calcified (n = 14). Layer 1 revealed the largest number of charred fragments (Table 2). Some fragments had developed cracks on the surface

Table 2: Bone modifications observed at Jaidak

Bone Modification/Layer	1	2	3	4	5	6	Total	%
Charred	5	15	0	0	1	3	24	1.35
Completely charred	38	23	0	3	1	4	69	3.87
Charred and calcified	7	6	0	1	0	0	14	0.79
Butchering marks	2	2	0	0	0	0	4	0.22
Cut marks	69	116	1	8	5	12	211	11.8
Embryonic bones	0	0	0	1	0	0	1	0.06
Gnawing marks	9	10	0	0	0	1	20	1.12
Rodent marks	1	0	0	0	0	0	1	0.06
Later intrusion	0	1	0	0	0	0	1	0.06
Pathological condition	0	3	0	0	0	0	3	0.17
Tools/attempted tools	10	4	0	0	0	0	14	0.79

% calculated w.r.t. n = 1782

besides charring because of intensive exposure to fire. Some fragments have peculiar patterns where charring has occurred at only the anterior end. For example, a tibia fragment belonging to family bovidae was charred at only the proximal end. Similarly, an axis vertebra was charred only at its cranial end. Interestingly, a similar charring pattern was noticed on a few skeletal elements recovered from Kanmer, a Harappan site in Kachchh, Gujarat (Goyal and Joglekar 2008).

Only three cases of pathologies were found in the entire assemblage: all belonging to layer 2. An ulna of cattle (JK161) showed that the animal has an extra growth at the proximal end. The animal was an adult and seems to have lived with this abnormality for a sufficient period of time before culled for food as the specimen was having both charring and cutting marks. One case of pathology was noticed on the radius-ulna recovered in the articulated form of a blackbuck (JK 164). It seems that the ulna got twisted due to some accident or injury, but remained attached to the radius. Another pathological condition was noticed in case of one cattle (JK54) metatarsal. This animal got a wound on the hind leg which perhaps got healed and the animal survived.

Only one case of an embryonic bone getting associated in the archaeological deposit has been found at Jaidak. A small ruminant metatarsal (*Bos/ Bubalus*) found from layer 4 (JK137) was of an embryo. It is very difficult to say whether it belonged to an aborted foetus or a pregnant female was culled accidentally.

The later intrusions of burrowing animals such as field rats and bandicoot rats are common in the archaeological sites. However, no such later date intrusion was noticed in the sample studied. A solitary case of later intrusion was of a humerus fragment belonging to bovidae in layer 2. This modern fresh bone perhaps was accidentally included in the assemblage.

Some bones in the assemblage showed the signs of modification by carnivores and rodents. A solitary case (metapodial of *Bos/Bubalus*) (JK1) of rodent gnawing has been found from layer 1. This bone fragment has fine parallel striation marks on the distal end, a characteristic feature of rodent gnawing. Many fragments belonging to various species and skeletal elements showed marks of carnivore (perhaps cat) teeth. These modifications, in the form of punctured marks/broad shallow grooves (generally made by cats) were observed on bones from layer 1, 2 and 6.

Several bone tools (Fig. 5) and fragments that looked liked tools have been recovered from only layer 1 and 2. Except three (JK 3, JK 40 and JK 168) tools made on *Capra/Ovis* bones, the rest were made using *Bos/Bubalus* bones. The tips of two tools were fire hardened (JK4 and JK135). Many of these tools showed marks of wearing due to their use. It is interesting that layer 2 revealed a large number of distal fragments of humerus belonging to *Bos/ Bubalus*. Most of these fragments were having cut marks and these looked like tools. The same layer also revealed many unidentified skeletal elements in the form of fragments of long bone shafts. It will be interesting to look at the faunal material from other trenches to know whether a similar pattern is visible there or not.

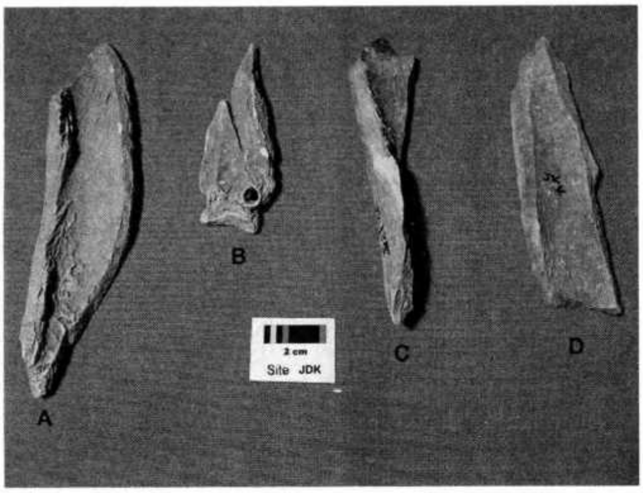

Fig. 5: Bone tools

The Fauna

The analysed material revealed several species that include mammals, reptiles and birds. In addition, a few molluscan species were identified from the assemblage. The faunal collection also revealed a few remains of fish in the form of vertebrae and skull fragments. These have been isolated and would be analysed later. However, the small number of aquatic fauna is quite interesting since the site is located very close to the Aji River.

Seven species of domestic animals were identified that includes the cattle, buffalo, sheep, goat, pig, dog and cat (Figs. 6-7). The wild mammals include 19 species, viz. antelopes, deer, wild pig, wild ass, carnivores, logomorphs and rodents (Figs. 8-11, see cover page 2). Besides these four species of reptiles (the Indian sawback turtle, Indian mud turtle and soft shell turtle), two bird species (peafowl and domestic fowl) and five species of molluscs (marine and fresh water) were identified (Table 3; Figs. 12-13, see cover page 2).

Domestic animals (89.16%) dominated the faunal assemblage and the contribution of wild animals to the subsistence activity is negligible. The bones of cattle and buffalo (68.77%) together constitute the major part of the sample examined, followed by that of sheep/goats (16.38%). The cattle bones were more in number than buffalo in all the layers. The presence of the bifid spinous processes of the thoracic vertebra suggests the existence of the typical humped or the zebu cattle. Though, a detailed study of the age of the animal at the time of death is yet to be done, a preliminary observation shows presence of several adult animals, and use of cattle for obtaining secondary products (such as milk and labour) apart from the meat. Presence of cut marks and charring marks on the skeletal fragments suggest that both cattle and buffalo were consumed.

Sheep/goats were the next most exploited animals at the site. It is clear due to presence of cut and charring marks on many skeletal elements that both sheep and goats were consumed. Goats were more than sheep in all the layers except layer 4. The low occurrence of non meat-bearing parts of the skeleton of sheep/goats (e.g. calcaneum, astragalus, metapodia, carpals, tarsals and phalanges) shows that these animals were not butchered in this part of the site (represented by sampled trench 5AC3). The contribution of the domestic pig was almost negligible in the subsistence economy of the people as only eight skeletal elements of the domestic pig were identified.

Other domestic animals included in the assemblage that were used neither for food nor as draft animals were dogs (*Canis familiaris*) and cats (*Felis catus*). These animals were relatively rare representing 0.28% (5 fragments) each of the assemblage. No human activity was noticed on these fragments and these were probably kept as pets like today.

Among the wild mammals, the most numerous were fragments of the gazelle (*Gazella bennetti*), blackbuck (*Antilope cervicapra*), sambar (*Cervus unicolor*), spotted deer (*Axis axis*) and barking deer (*Muntiacus muntjak*) forming 4.05% of the NISP (Table 3). The presence of both meat-bearing and non meat-bearing parts in the assemblage suggests that these animals were hunted near the site and butchered in the living area. Both male and female spotted deer were noticed in the faunal assemblage. These animals probably supplemented to the food base provided by the domestic animals.

The nilgai (*Boselaphus tragocamelus*) has been found from the first two layers. Twelve bone fragments were identified that includes various skeletal elements such as teeth, mandible, metapodia, tibia, humerus and astragalus. Both nilgai bulls and cows were present in the faunal material. Skeletal elements of the nilgai are devoid of cutting and charring marks. However, looking at the other Harappan sites in the region, it is certain that the nilgai was used for the dietary purpose. A complete

Table 3: NISP at Jaldak

Species\Layer	1	2	3	4	5	6	NISP	%
Bos indicus	46	64	5	8	6	10	139	7.8
Bubalus bubalis	4	8	1	2	0	4	19	1.07
Bos/Bubalus	495	512	17	19	4	21	1068	59.9
Capra hircus	3	7	0	0	1	2	13	0.73
Ovis aries	0	4	2	2	0	0	8	0.45
Capra hircus/Ovis aries	106	124	8	14	10	8	270	15.2
Sus domesticus	4	3	0	1	0	0	8	0.45
Canis familiaris	2	3	0	0	0	0	5	0.28
Felis catus	0	4	0	0	0	1	5	0.28
Boselaphus tragocamelus	6	6	0	0	0	0	12	0.67
Sus scrofa	3	3	0	0	0	0	6	0.34
Equus heminous	1	0	0	0	0	0	1	0.06
Equus sp.	0	1	0	0	0	0	1	0.06
Panthera pardus	0	1	0	0	0	0	1	0.06
Felis chaus	3	0	0	0	0	0	3	0.17
Hyaena hyaena	1	0	0	0	0	0	1	0.06
Canis aureus	0	3	0	0	0	0	3	0.17
Viverrivula indica	1	0	0	0	0	0	1	0.06
Paradoxurus hermophroditus	0	1	0	0	0	0	1	0.06
Cervus unicolor	3	2	0	0	0	1	6	0.34
Axis axis	10	8	0	0	0	0	18	1.01
Muntiacus muntjak	3	0	0	0	0	0	3	0.17
Antilope cervicapra	7	22	1	1	1	2	34	1.91
Gazella bennetti	3	5	0	1	0	2	11	0.62
Herpestes edwardsi	1	2	0	0	0	0	3	0.17
Hystrix indica	1	2	0	0	0	0	3	0.17
Lepus nigricollis	6	13	1	7	2	6	35	1.96
Bandicota indica	1	0	0	0	0	0	1	0.06
Small mammal	5	8	0	1	0	2	16	0.9
Kachuga tecta	2	2	0	0	0	0	4	0.22
Trionyx gangeticus	0	2	0	0	0	0	2	0.11
Lissemys punctata	0	8	0	0	0	1	9	0.51
Varanus bengalensis	2	4	0	0	0	0	6	0.34
Pavo cristatus	0	2	0	0	0	0	2	0.11
Gallus domesticus	0	0	0	0	0	1	1	0.06
Lamellidens sp.	8	19	12	9	3	5	56	3.14
Corbicula sp.	0	0	1	0	0	0	1	0.06
Diginostoma pulchella	0	1	0	0	0	0	1	0.06
Turbinella pyrum	0	2	0	0	0	0	2	0.11
Land snail (unidentified)	0	2	0	0	0	1	3	0.17
Total	**727**	**848**	**48**	**65**	**27**	**67**	**1782**	**100**

second premolar (JK122) of upper jaw of the wild ass (*Equus heminous*) was recovered from layer 1. A broken upper first molar (JK81) belonging to family equidae has been recorded from layer 2. This fragment was identified only at a generic level, i.e. the *Equus* sp.

The panther (*Panthera pardus*) was present in the form of only one bone fragment, i.e. the fragment of the left mandible (JK 163) from layer 2. Similarly, a single fourth metatarsal fragment recovered from layer 1 attests presence of the hyena (*Hyaena hyaena*). Three skeletal fragments of the jackal (*Canis aureus*) - the proximal portion of a scapula (JK82), a fragment of the left maxilla (JK83), and a cervical vertebra (JK84) - were found in the sample examined. Skeletal elements of panther, jackal and the hyena

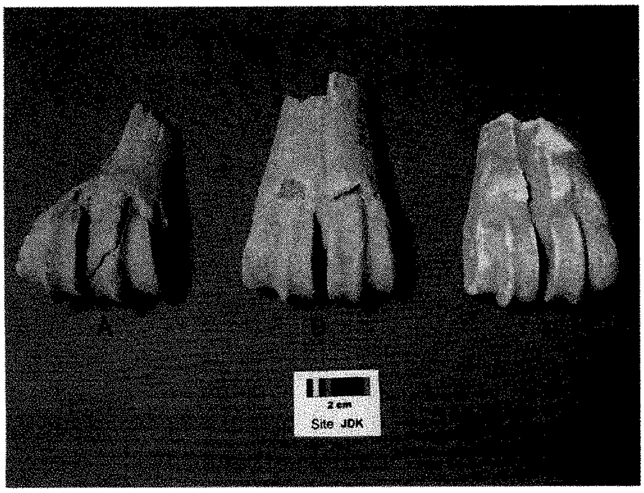

Fig. 6: Metpodia of cattle

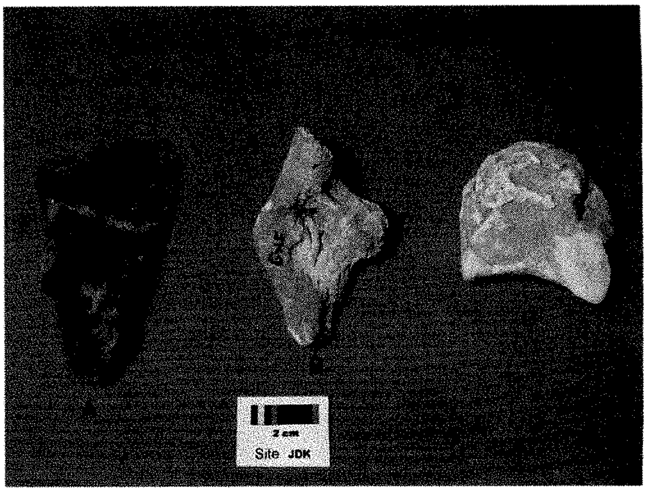

Fig. 7: Buffalo bones

do not bear any marks of human activity and perhaps their inclusion in the assemblage may be due to some reason other than consumption.

The jungle cat (*Felis chaus*) that looks like a small leopard is commonly found throughout India today, though their numbers are decreasing rapidly. These cats live in open and scrub forests, and bamboo thickets along riverbanks, marshy areas. Three skeletal elements of this species-ulna (JK128), first phalanx (JK 129) and radius (JK133) were recovered from the first layer. No human activity was noticed on them.

Two different civets, the Small Indian Civet (*Viverrivula indica*), and the Common Palm Civet or Toddy Cat (*Paradoxurus hermophroditus*) have been identified from the assemblage in the form of one bone each. The Small Indian Civet at present is found throughout India. This omnivorous and nocturnal animal prefers open bushy forests with tall grass. A complete right mandible (JK50) that shows the marks of charring was found from layer 1. At present the civets are valued for their scent glands (Prater 1965), however, it is not certain if this was the case at Jaidak. The Common Palm Civet or Toddy Cat lives in dense forests in tree holes but is adapted to live in human settlements in abandoned rooms and below roofs. It feeds on small birds and mammals and poaches upon poultry birds. A complete left mandible (JK 65) of this species was found from layer 2.

The mongoose (*Herpestes edwardsi*) and porcupine (*Hystrix indica*) were the small game utilized at Jaidak. The skeletal elements of the mongoose identified were two fragments of the ilium and one broken isolated maxillary incisor. It is clear from the MNI calculation that one animal each of both these species was found in layer 1 and layer 2. The hare (*Lepus nigricollis*) seems to have been a common small game valued in the food economy at Jaidak 35 bone fragments of the hares were found in different layers.

The non-mammals (reptiles and birds) found in the assemblage are very few and do not seem to have contributed greatly to the food items at Jaidak. The reptile group revealed the presence of 4 species- the monitor lizard (*Varanus bengalensis*), softshell turtle (*Trionyx gangeticus*), Indian mud turtle (*Lissemys punctata*), and Indian sawback turtle (*Kachuga tecta*). Varanus is represented by 6 vertebrae recovered from the first two layers. All the three turtle species and the monitor lizards were used as food items. The avifauna represented in the assemblage was in the form of three fragments only, two belonging to *Pavo cristatus* and one to *Gallus domesticus*.

Bone Measurements (Tables 4-8)

Recording bone measurements is an essential part of standard archaeozoological methodology. The bone measurements provide a tool to look at the sizes of past animals, particularly the domestic ones. With the estimates of the size and height of the animals at the withers, it is possible to compare the domestic stocks at various archaeological sites and in different cultural periods (Joglekar 2000-2001). All the measurements were recorded in mm using a digital calliper with a least count of 0.01 mm. Three estimates of cattle height at the withers using the medial length of the astragalus (Zalkin 1970) are available from Jaidak.

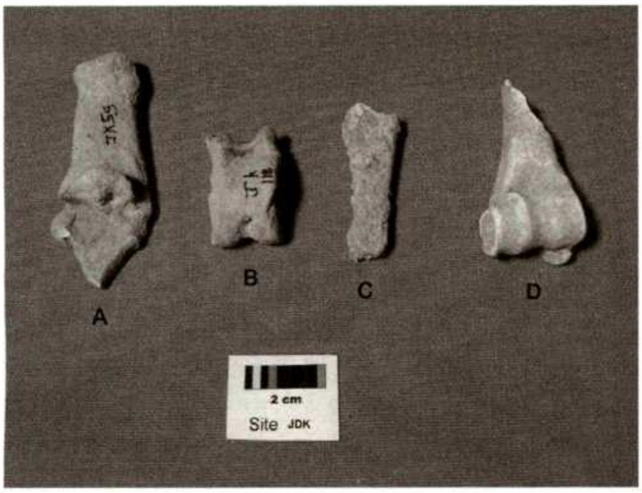

Fig. 9: Bones of blackbuck

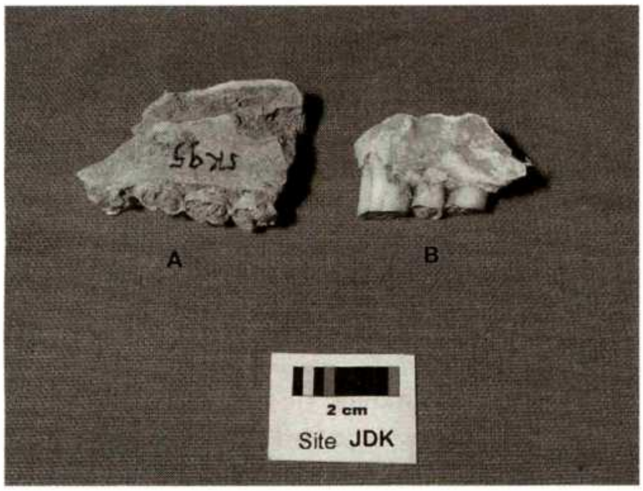

Fig. 10: Bones of porcupine

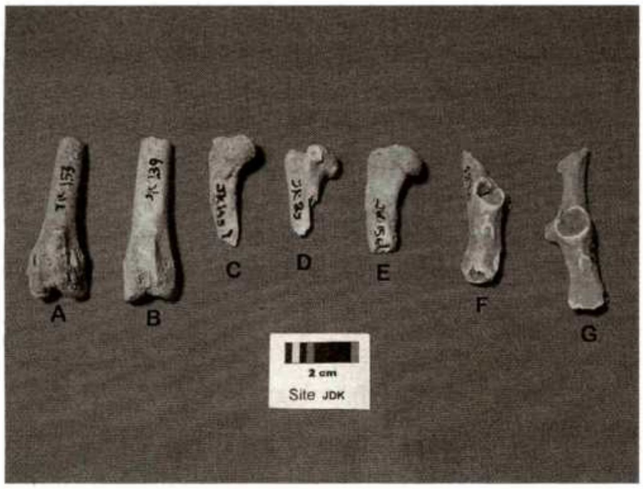

Fig. 11: Bones of *Lepus nigricolis*

These are 104.75, 106.21 and 116.52 cm. These are comparable to the estimates (range: 110.2 to 117.50 cm) obtained for cattle in the Late Harappan Phase at Kanmer (Joglekar 2007; Goyal and Joglekar 2008).

The distal width of the trochlea of the humerus can be converted to estimate the fat-free carcass weight (kg) using the factor given by Noddle (1973). Three such estimates obtained from the cattle humerus at Jaidak are 106.04 and 120. 38 kg. At present it is not possible to comment on the size profile of cattle at Jaidak since the data related to size are not statistically adequate, but the available estimates could be used for comparative purpose in future.

Conclusions

This preliminary report on the faunal remains from Jaidak shows that in general, the economy was dependent on domestic animals, however, it is also noticed that the exploitation of wild animals was at its peak towards the close of the Harappan period(layers 1 and 2). Of course, one has to keep in mind that among all layers in the trench the first two layers produced more skeletal fragments in comparison to other layers. Yet it is also important to note that other Harappan sites in Gujarat such as Rangpur (Nath 1962-63), Surkotada (Sharma 1990), Nageswar (Shah and Bhan 1992), Kuntasi (Thomas *et al.* 1996), Shikarpur (Thomas *et al.* 1995) and Kanmer (Goyal and Joglekar 2008) also reveal same sort of animal exploitation patterns during the late phase of Harappan period.

A quick glance on the faunal studies done on other Sorath Harappan sites such as Kuntasi (Thomas *et al.* 1996) and Rojdi (Kane 1989; Possehl *et al.* 1985) reveals that animal-based subsistence activities of these sites were not different from those of classical Harappan sites in Gujarat. Both types of sites have revealed a dependence on cattle and sheep/goat and this food base from domestic animals was supplemented by hunting and fishing. The same can be said about Jaidak where the assemblage is dominated by cattle and sheep/goat.

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Table 4 Measurements of long bones (in mm)

Reg. No.	Layer	Bone	Species	Bp	Bd	Td
JK89	2	Femur	*Lepus nigricollis*	11.50	--	--
JK139	4	Femur	*Lepus nigricollis*	--	17.36	--
JK153	6	Femur	*Lepus nigricollis*	--	17.35	--
JK37	1	Humerus	*Bubalus bubalis*	--	62.71	--
JK38	1	Humerus	*Bos indicus*	--	56.05	--
JK48	1	Humerus	*Antilope cervicapra*	--	23.19	21.11
JK63	2	Humerus	*Axis axis*	--	30.45	--
JK86	2	Humerus	*Bubalus bubalis*	--	64.13	--
JK149	4	Humerus	*Lepus nigricollis*	--	12.95	--
JK156	6	Humerus	*Lepus nigricollis*	13.95	--	--
JK20	1	Radius	*Bos indicus*	62.51	--	--
JK101	2	Radius	*Bos indicus*	60.73	--	--
JK120	2	Radius	*Gazella bennetti*	27.26	--	--
JK160	2	Radius	*Bos indicus*	63.13	--	--
JK66	2	Tibia	*B. tragocamelus*	--	46.55	37.45
JK162	2	Tibia	*Bos indicus*	--	48.82	37.00

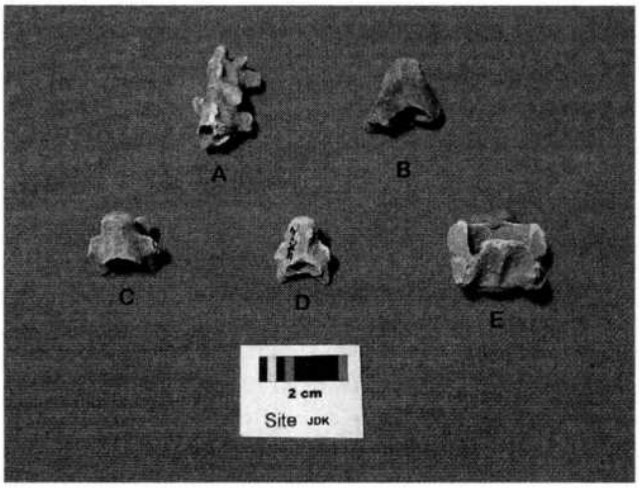

Fig. 12: Skeletal elements of reptiles

material. The authors also thank Prof. V.H. Sonawane, Drs. Ajithprasad, S. Prathapachandran and Ambika Patel for their help during our stay at Baroda. Special thanks to Rajesh, who not only helped in digging out the material from the basement storage, but also cheerfully helped in many ways.

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Table 5: Measurements of astragali (in mm)

Reg. No.	Layer	Species	GLl	GLm	Bd
JK13	1	*Bos indicus*	62.31	57.24	34.83
JK46	1	*Gazella bennetti*	26.54	24.69	14.62
JK47	1	*Capra hircus*	31.12	28.81	19.26
JK30	1	*Bos indicus*	64.6	58.04	37.67
JK88	2	*Bos indicus*	70.77	63.67	44.21
JK104	2	*Sus scrofa*	42.57	37.92	24.75
JK118	2	*Antilope cervicapra*	31.67	30.43	18.37
JK138	4	*Bubalus bubalis*	61.1	54.80	41.77
JK158	6	*Bos indicus*	71.55	--	45.55

GLl : Lateral Length GLm : Medial length Bd : Maximum distal width

Table 6: Measurements of first and second phalanges (in mm)

Reg. No.	Layer	Bone	Species	Gl	Bp	Tp	Bd
JK60	2	First phalanx	*A. cervicapra*	43.00	12.22	15.72	10.28
JK166	2	First phalanx	*A. cervicapra*	--	10.36	13.74	--
JK127	1	First phalanx	*A. cervicapra*	22.72	9.72	12.32	8.35
JK154	3	First phalanx	*A. cervicapra*	43.44	8.80	14.29	9.63
JK97	2	First phalanx	*Bos indicus*	--	--	--	20.23
JK141	6	First phalanx	*Bos indicus*	52.65	--	--	26.00
JK94	2	First phalanx	*Bos indicus*	58.64	19.17	32.00	28.30
JK145	4	First phalanx	*Bos indicus*	59.00	24.16	28.96	26.35
JK201	4	Second phalanx	*A. cervicapra*	22.90	9.60	12.21	8.30
JK71	2	Second phalanx	*B. tragocamelus*	43.00	25.54	28.26	20.63
JK143	6	Second phalanx	*Bubalus bubalis*	45.52	29.69	32.64	24.90

GL : Maximum length, Tp : Proximal thickness
Bp : Maximum proximal width Bd : Maximum distal width

Table 7: Measurements of isolated teeth (in mm)

Reg. No.	Layer	Species	Tooth		Length	Width
JK125	1	*Bos indicus*	Mandibular	dP4	31.21	14.07
JK29	1	*Bos indicus*	Mandibular	First/Second molar	20.73	13.47
JK121	2	*Bos indicus*	Mandibular	First/Second molar	26.60	16.40
JK80	2	*Bos indicus*	Mandibular	Fourth premolar	19.50	9.15
JK74	2	*Bos indicus*	Mandibular	Third molar	30.00	10.46
JK119	2	*Capra hircus*	Mandibular	First/Second molar	14.62	9.84
JK35	1	*Axis axis*	Maxillary	Second premolar	14.00	16.24
JK8	1	*Bos indicus*	Maxillary	Second molar	26.19	17.02
JK11	1	*Bos indicus*	Maxillary	Second premolar	17.25	23.19
JK51	5	*Bos indicus*	Maxillary	Second premolar	18.10	20.05
JK34	1	*Bos/Bubalus*	Maxillary	Second premolar	13.00	8.70
JK16	1	*B. tragocamelus*	Maxillary	First/Second molar	20.13	25.81
JK124	1	*B. tragocamelus*	Maxillary	First/Second molar	17.78	13.04
JK10	1	*B. tragocamelus*	Maxillary	Second molar	20.82	22.38
JK21	1	*Capra hircus*	Maxillary	Third molar	17.80	11.11
JK75	2	*Capra hircus*	Maxillary	Third molar	16.50	12.40
JK76	2	*Capra/Ovis*	Maxillary	First/Second molar	14.46	11.47
JK69	2	*Hystrix indica*	Maxillary	First/Second molar	10.06	9.24

Table 8: Measurements of shells of Lamellidens sp. (in mm)

Reg. No.	Layer	Length	Width
JK174	1	47.12	25.42
JK175	1	50.00	28.00
JK176	1	41.66	26.74
JK171	2	35.56	21.36
JK179	2	41.59	23.14
JK180	2	37.72	17.06
JK183	3	--	21.71
JK184	3	41.93	21.84
JK185	3	53.40	28.02
JK172	4	--	26.04
JK173	4	37.59	19.61
JK181	5	44.07	24.65

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Faunal Remains from the Iron Age and Early Historical Settlement at Mahurjhari, District Nagpur, Maharashtra

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Abstract

Animal remains are a common component of most Iron Age/Megalithic sites in the Vidarbha region of Maharashtra. These have been found in association with human burials as well as in habitation deposits. As most of the faunal data was recovered from burials, faunal exploitation in Megalithic/ Iron Age habitational context has not been properly studied. In this regard the 2001-2004 excavations at Mahurjhari are important as they have helped unearth a Megalithic/Iron Age habitation as well as an Early Historical settlement. In this paper are presented results of the faunal analysis carried out on the animal remains recovered from both these settlements. The detailed study has provided fresh insights into aspects related to the use of different animals and their role in the Iron Age and Early Historic subsistence economy at the site.

Introduction

The early part of the first millennium B.C. witnessed the emergence of the Iron Age culture in the Vidarbha region of Maharashtra. A large concentration of Iron Age sites comprising both burials as well as habitation were brought to light since their investigations began in 1879 by Rivett-Carnac. Out of more than 100 megalithic sites found in Maharashtra, 95 are found in Vidarbha alone. Around 2831 burial circles are reported of which only 69 have been exposed (Mohanty and Joshi 1996; Mohanty and Walimbe 1993). These sites fall under three broad categories: (1) megalithic burial sites, (2) megalithic burial cum habitation sites, and (3) settlement sites without burials in the vicinity but with a megalithic cultural phase (Mohanty 2003). The burial sites are mostly cairn circles, but at few sites menhirs, pit burials and cist burials are also evident. Some important excavated sites are (Table 1).

Faunal Background of the Vidarbha Iron Age

At most excavated sites a rich repertoire of cultural finds such as copper and iron objects comprising hoes, plough shares, daggers, spears, tridents, knives, and bells, ceramics like black and red ware, micaceous red ware, horse ornaments, gold beads, semi-precious stone beads have been encountered (Deo 1982, 1985). Along with these are also found plant, human and animal remains

Of these the faunal remains have received considerable attention and were primarily studied from two contexts: Megalithic burial sites and from b) Megalithic habitation deposits (Table 1).

Fauna from Megalithic/Iron Age burial sites

The burial sites from Vidarbha which mainly consist of stone circles have also yielded animal bones besides other antiquities. These are evident at sites like Junapani, Mahurjhari, Raipur, Borgaon, Naikund and Khapa. At all these sites partial skeletal elements from the skull, teeth, phalanges, limb bones are represented. These exhibit poor preservation as the deposit which is mostly the black cotton soil is partly responsible for the poor preservation of bones. Some of the bones are with cut marks signifying butchering activity and despite their fragmentary nature were identified as belonging to the domestic horse (*Equus caballus*). At Naikund besides the horse, cattle remains were also reported (Thomas 1992a). Frequent occurrence of horse remains with burial sites constitutes a unique feature of the Vidarbha Iron

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Table 1: Faunal studies from Iron Age sites in Vidarbha Maharashtra

Site	Abbr	Reference	Burial	Habitation	Faunal Study
Bhagimohari	BMR	IAR 1982-83: 61-62, IAR 1983-84: 57-58	-	+	Thomas 1993b
Takalghat	TKP	Deo 1970	+,	+	Rao 1970
Naikund	NKD	Deo and Jamkhedkar 1982	+	+	Badam 1982
Khairwada	KRD	IAR 1981-82:51-52	-	+	Thomas 1993a
Tharsa	THR	IAR 1985-86: 58-59.	-	+	Joglekar and Thomas 1997-98
Kaundinyapura	KND	Dikshit 1968	-	+	Shah 1968
Paunar	PNR	Deo and Dhavalikar 1968	-	+	Rao 1968
Mahurjhari	MHR	Deo1973	+	-	Rao 1973, Thomas 1992a
Raipur	RPR	Deglurkar and Lad 1992.	+	-	Thomas 1992b & c
Borgaon	BRG	IAR 1980-81: 40	+	-	Thomas 1992a
Adam III	ADM	IAR 1988-89:50-55; IAR 1990-91: 45-50; IAR 1991-92:63-69, Nath 1992	-	+	Thomas *et al.* in press

Meg-B - burials , Meg-H- habitation, presence + , absence -

Age. Whereas their scarce occurance is observed in habitation sites as compared to other animal bones.

Fauna from Megalithic Habitation Sites

In Vidarbha very few Iron Age sites have habitation deposits associated with them. Sites like Takalghat-Khapa, Mahurjhari, Naikund, Khairwada and Bhagimohari are both habitation cum burial sites and some of them are located on the banks of perenial rivers. Whereas at Kaundinyapura (Dikshit 1968), Paunar (Deo and Dhavalikar 1968), Arni (IAR 1984-85: 55-56) and Adam (IAR 1988-89: 50-55; IAR 1990-91: 45-50; IAR 1991-92: 63-69, Nath 1992) megalithic occupational levels are reported but do not have burials associated with them. At most sites, the habitation is found to continue from the Megalithic levels into the Early Historical period as seen at sites like Adam, Paunar and Kaundinyapura.

As compared to the burials, very few habitation sites have been reported and excavated such as Takalghat, Bhagimohari, Naikund, Khairwada, Tharsa, Adam, Kaundinyapura and Paunar. At all these sites the habitation deposits have yielded a higher concentration of animal bones showing better preservation. Bone identification carried out on faunal remains from these sites has revealed a wide-ranging fauna Animals ranging from domestic such as cattle, pigs, goats to a wild fauna like gaur, deer, antelopes have been identified. The studies have also revealed the use of birds and aquatic animals like turtles, crabs and freshwater molluscs in the food economy (Thomas 1992a, Deshpande-Mukherjee *et al.* in press, Table 2).

Since much of the faunal data has been mostly obtained from burial context, information on the faunal exploitation at Megalithic/Iron age habitation sites has not been properly studied.

It is on this background that, results of the analysis on the animal remains unearthed from the recent excavations at Mahurjhari are being presented. The detailed study is hoped to provide fresh insights into aspects related to the varied use of different animals and their role in the Iron Age and Early Historic subsistence economy at the site. An attempts was also made to study the possible changes in faunal exploitation from the Megalithic to the Early Historical period at the site.

The site

The site of Mahurjhari (21° 14’ N; 79° 30’ E) lies 15 km to the west of the modern city of Nagpur (Fig.1). Its presence, however, first went unnoticed by Rivett-Carnac who as early as 1879 reported the stone circles at Junapani (Rivett-Carnac 1879). Mahurjhari was reported for the first time by Hunter in 1933 but in his account of the antiquities reported by him it was found that they were of the Early Historical period and had nothing to do with the Iron Age

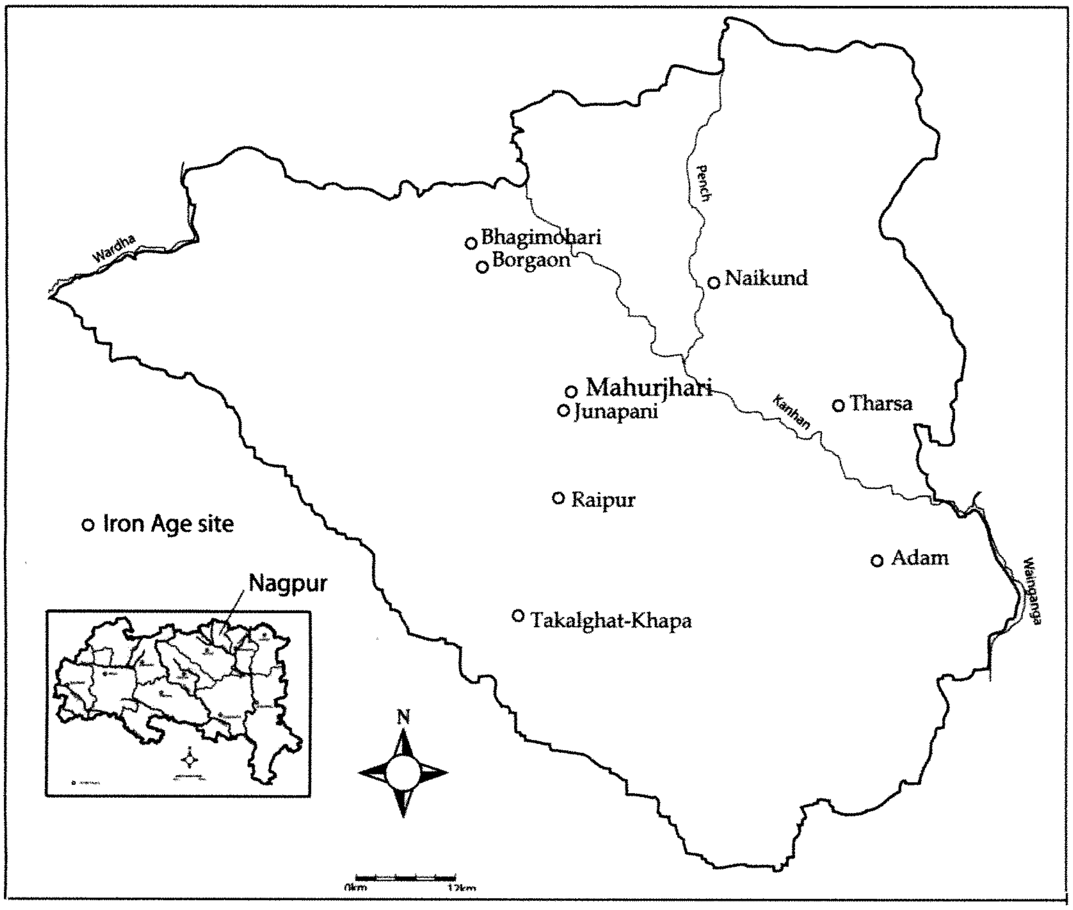

Fig. 1: Map of Mahurjhari and other Iron Age/Megalithic sites in Nagpur district, Maharashtra

period (Hunter 1933). After a long gap Mahurjhari was excavated by S.B. Deo for two seasons from 1970-71 and 1971-72. The excavations revealed that the Megalithic burials at Mahurjhari were rich in antiquities as compared to other sites in the Vidarbha region (Deo 1973). Numerous stone circles were brought to light and some were excavated. Excavation of the burials yielded ceramics, iron objects, semi precious stone beads, human skeletal remains and horse bones. The overall cultural material unearthed revealed the cultural importance of Mahurjhari. Out of the 16 excavated megaliths, 14 yielded material of physical and cultural relics. Of these animal bones of horse *(Equus caballus)* found associated with burials were studied (Rao, 1973).

Between 2001 and 2004, Mahurjhari was once again taken up for excavations by the third author.. The three season's excavation gave adequate evidence for the occupation of Mahurjhari in both the Iron Age and Early Historical period. The presence of large quantities of stone beads in various stages of manufacture strongly indicated the possibility of Mahurjhari as an important bead-manufacturing centre since the Iron Age (Mohanty 1999, 2003).

At Mahurjhari the early Iron Age settlement was discovered as a nearly intact mound under cultivation close to a small stream. The trench MHR-MS-A measuring 5 x 5m was laid on an elevated deposit on the western side of the mound close to the road. The total cultural deposit was about 2.05 m. It was excavated in all four quadrants, SW, NW, NE and SE. NE was further divided into two parts of 2.5 x 1.25 m each, and were called A&B. It was excavated to a depth of 2.31 m. From this trench charred grains, animal bones, iron implements and ceramics like micaceous red ware, black and red ware were found. Animal bones were studied mainly from the NE and SE quadrant. From another trench MHR-MS-B, animal bones were studied to a depth of 70 cm in all the four quadrants.

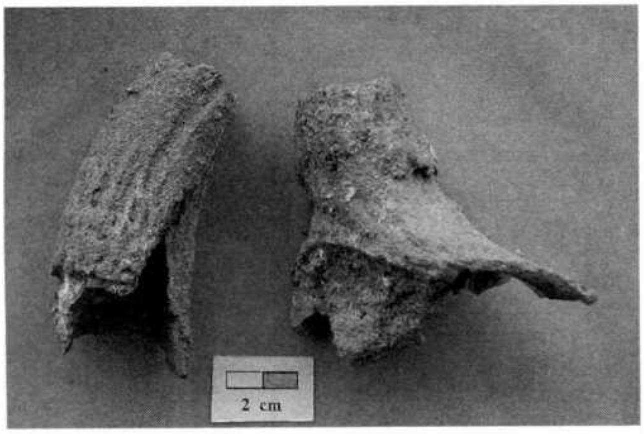

Fig. 2: horn cores of *Bos indicus*

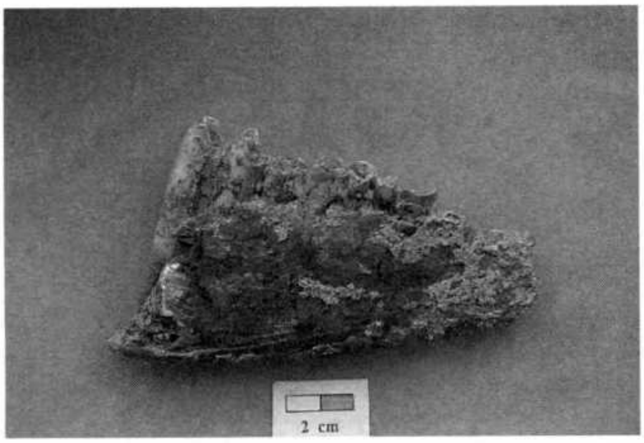

Fig. 3: mandible of *Bos indicus*

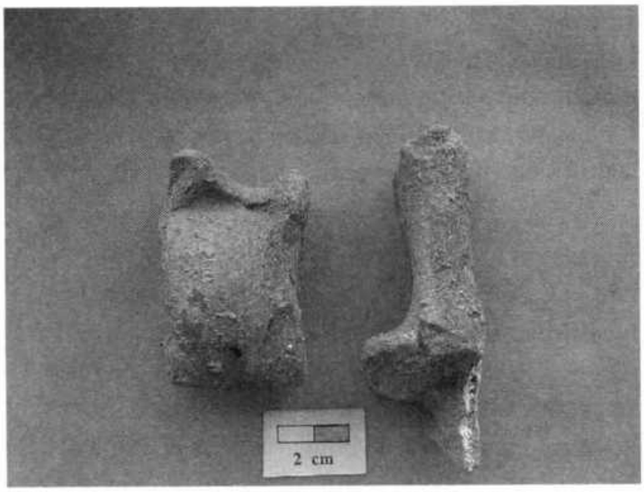

Fig. 4: Astragalus and calcaneum of *Bos indicus*

In case of the Early Historical settlement it is located about 1 km north of the Megalithic settlement and the mound is spread over an area of five hectares having a deposit of 1.25 to 1.80 m. The excavation was carried out at several places, as the centre portion is currently inhabited. No Iron Age deposit was found below the Early Historical levels. Due to the limited nature of the excavation no proper structural remains could be found. However, a large amount of full sized burnt bricks and brickbats belonging to the Satavahana and the Gupta-Vakataka period were recovered. Also found were Early Historic pottery, glass beads, bangles, shell bangles, terracotta animal and human figurines, iron objects, and semi precious stone beads in various stages of manufacture. Faunal remains were recovered from both the Megalithic settlement area as well as the Early Historical levels.

Faunal material from the following trenches MS-A and MS-B in the Megalithic settlement area. Trench A, B, C, D and F from the Early Historic deposit was made available for the study. Its analysis was carried out at the Archaeozoology Laboratory of the Deccan College, Pune using standard procedures applied in faunal analysis. Bone identification was done with the help of the modern reference collection of animal skeletal elements housed in the Archaeozoology Laboratory and by referring to Schmidt's *Atlas of Animal Bones* (Schmidt 1972).

Bones ranging from large to small-sized fragments were weighed, numbered and recorded. Dimensional measurements were taken of all the measurable bones. Taphonomic features like cut and chop marks, gnawing, modification by humans and natural elements on the bones were recorded. Species identification was attempted to the species level. In case of certain bones where species separation was not possible due to the absence of specific markers, these were classified under broad categories such as cattle (*Bos/Bubalus*), goat/sheep (*Capra/Ovis*) and small ruminants.

In case of molluscan shells identification was also attempted to the species level. Shell identification was done by referring to Subba Rao (1989) and Apte (1998). Measurements involved taking the length and breadth of shells. Observations like charring, abrasion, breakage pattern, perforation, modification, etc. were also recorded.

Results

The faunal analysis carried out on animal bones and shells from the Iron Age and Early Historical

Table 2: Faunal representation at Iron Age habitation sites in Vidarbha

Species	**BMR**	**TKP**	**NKD**	**KRD**	**THR**	**KND**	**PNR Pd.I**	**ADM III**
Bos indicus (cattle)	+	+	+	+	+	+	+	+
Bubalus bubalis (buffalo)	-	+	+	+	+	-	-	+
Capra hircus (goat)	+	+	+	+	-	+	+	+
Ovis aries (sheep)	-	+	+	-	-	-	+	-
Sus domesticus (pig)	+	-	+	+	-	-	+	+
Equus caballus (horse)	+	+	+	-	-	-	-	+
Canis familiaris (dog)	-	-	+	-	+	-	-	+
Felis catus (cat)	-	-	-	-	-	-	-	+
Bos gaurus (gaur)	-	-	+	-	-	-	-	+
Boselaphas tragocamelus (nilgai)	-	-	-	-	-	-	-	+
Capra/Ovis (wild goat/sheep)	-	-	+	-	-	-	-	-
Cervus unicolor (sambar)	+	+	+	+	+	-		+
Axis axis (chital)	-	-	+	+	+	-	-	+
Axis porcinus (hog deer)	-	-	-	-	+	-	-	-
Muntiacus muntjak (barking deer)	+	-	-	-	-	-	-	-
Tragulus meminna (mouse deer)	-	-		+	-	-	-	-
Tetracerus quadricornis (four horned antelope)	+	-	-	+	-	-	-	-
Antilope cervicapra (blackbuck)	-	-	-	-	+	-	-	+
Sus scrofa (wild pig)	-	+	+	-	+	-		+
Lepus nigricollis (hare)	+	-	-	-	-	-	-	-
Rattus rattus (house rat)	-	+	-	-	-	-	-	+
Unknown species of bird	+	-	-	+	+	-	-	-
Gallus domesticus (chicken)	-	+	-	-	-	-	-	+
Gallus sp. (fowl)	+	-	-	-	-	-	-	-
Anser indicus (goose)	+	-	-	-	-	-	-	-
Antegone sp. (crane)	+	-	-	-	-	-	-	-
Turtle/Tortoise	+	-	-	+	-	-	-	-
Trionyx gangeticus	-	-	--	-	-	-	-	+
Lissemys punctata (pond turtle)	+	-	-	-	-	-	-	+
Varanus sp. (Monitor lizard)	+	-	-	-	-	-	-	+
Crab	+	-	-	-	-	-	-	-
Lamellidens marginallis	+	+	+	+	-	-	-	+
Corbicula sp.	+	-	-	+	-	-	-	+
Dignostoma pulchella	+	-	-	-	-	-	-	-
Pila globosa	-	-	-	-	-	-	-	+
Viviparus bengalensis	-	+	+	-	-	-		-
Melania striatella tuberculata	-	-	-	+	-	-	-	-
Turbinella pyrum	-	-	-	+	-	-	-	-
Cypraea arabica	-	-	-	+	-	-	-	-

+ present; -absent

settlement at Mahurjhari has revealed a diverse range of animals that were exploited in the past (Tables 3-4). A total of 2308 bones were studied. The bones show fairly good preservation although a high rate of bone fragmentation is visible. Due to this reason, measurements were possible only for a few bones (Tables 5-9). Almost all skeletal parts were present in the collection but representation of ribs, vertebrae, phalanges, teeth is more. These bones are often well preserved because of their size and hard nature. Many of the bones show traces of charring, cut marks and intentional modification.

The overall faunal analysis shows that a majority of the bones recovered from the Iron Age and Early Historical settlement have resulted mainly from subsistence related activities. However, a few bones were accidentally introduced because of natural agencies and post-depositional disturbances. The

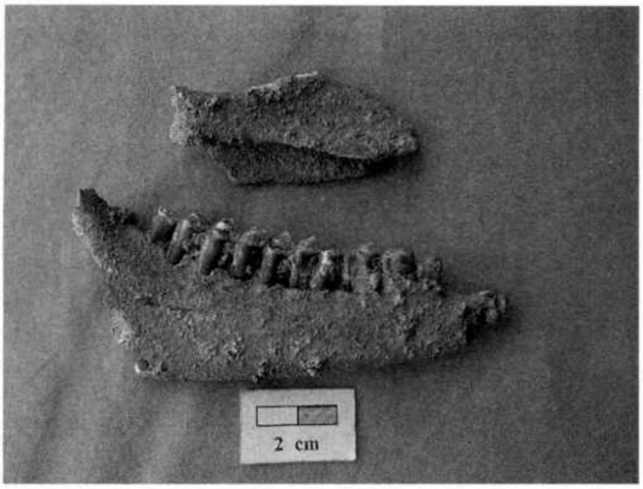

Fig. 5: Scapula of sheep (*Ovis aries*) above, below-mandible of goat (*Capra hircus*)

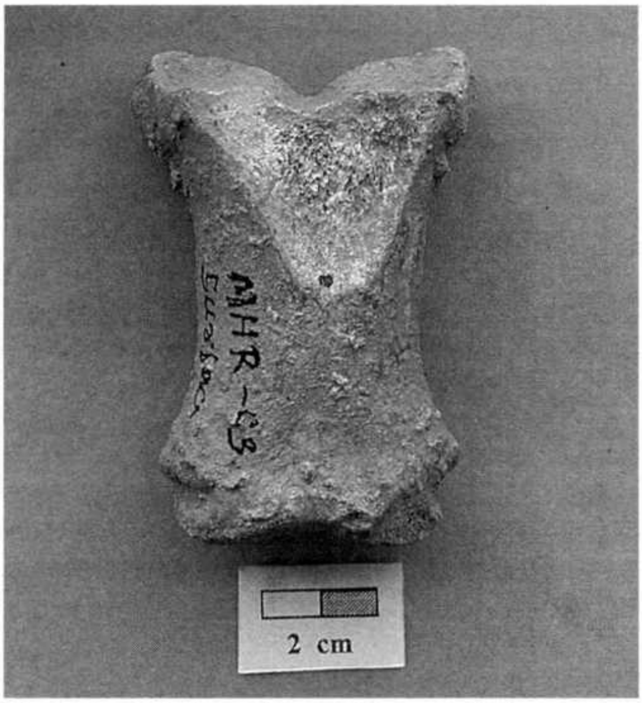

Fig. 6: First phalanx of horse (*Equus caballus)* with cut mark

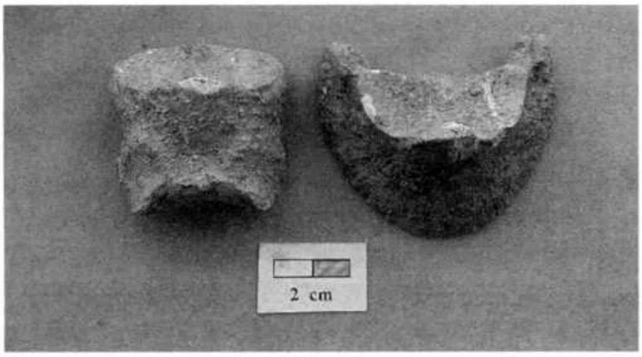

Fig. 7: Second and third phalanx of horse (*Equus caballus*).

following categories of animals were identified in the megalithic habitation and in the Early Historical level.

Domestic Fauna

Cattle (Cow/bufallo **(***Bos indicus* and *Bubalus bubalis)* In both the Iron Age as well as Early Historical period, cattle bones are predominant in the entire bone assemblage. The bones comprised horn cores, mandibles, teeth, astragali, phalanges and long bones. These belong to the domestic variety of cow/ox (*Bos indicus)* and buffalo (*Bubalus bubalis).* As bones of both these animals are very close in characters it is generally difficult to differentiate between them. Hence are grouped together as *Bos/ Bubalus* sp. At Mahurjhari inspite of the fragmented condition of most bones, some amount of separation was possible. Of these bones of cow/ox are more as compared to buffalo (Fig. 2, 3 and 4). Buffalo bones comprising a scapula with a cut mark and a fragment of a maxilla were identitfied from the Iron Age settlement MHR MS-B.

Presence of charring, cut marks on the bones alongwith meat bearing parts in the assemblage strongly suggests the dietary use of cattle in both periods. These may have also served as traction animals and used in agricultural activities. On the basis of the teeth and unfused condition of the bones many of the animals were killed at a young age. The general large-scale presence of cattle bones in both the periods shows the economic importance of cattle in particular at the site.

Goat/sheep *(Capra hircus/Ovis aries)* Both these animals were found in more or less similar proportions in the Iron Age as well as Early Historical levels (Fig. 5)**.** These animals also because of their close similarity in skeletal morphology are difficult to separate. Hence were grouped as *Capra/Ovis* wherever identification was not possible. The goat is more commonly represented by parts of its mandible, teeth, pelvis, vertebra, ribs, metapodials, humerus, femur, etc. Many of the bones show charring as well as traces of butchering suggesting its dietary use. The sheep *Ovis aries* was identified in the Megalithic/Iron age settlement by a fragment from the scapula.

Pig (*Sus domesticus)* is represented by parts of mandible, maxilla, teeth, tibia and metapodials

Table 3: List of mammals, reptiles, birds and fish found at Mahurjhari

Species	Abbr	Meg/Ia	Eh
Bos/Bubalus	B/B	169	62
Bos indicus (domestic cow)	Bi	95	12
Bubalus bubalis (domestic buffalo)	Bb	3	0
Capra hircus (goat)/*Ovis aries* (sheep)	C/O	14	16
Capra hircus	Ch.	12	15
Ovis aries (sheep)	Oa	1	0
Canis familiaris (dog)	Cf.	11	5
Sus domesticus (pig)	Sd.	5	1
Equus caballus (horse)	Ec	3	0
Felis catus (cat)	Fd.	-	4
Small ruminant	SR	31	18
Gallus domesticus (chicken)	Gd	4	3
Tetracerus quadricornis (chowsingha)	Tq	4	0
Axis axis (chital)	Aa	1	6
Antilope cervicapra (black buck)	Ac	8	2
Boselaphus tragocamelus (nilgai)	Bt	3	0
Canis lupus (wolf)	Cl	1	2
Sus scrofa (wild pig)	Ss	4	0
Panthera pardus (leopard)	Pp	2	0
Lepus nigricollis (hare)	Ln	0	2
Herpestes edwardsi (mongoose)	He	1	0
Varanus sp. (monitor lizard)	Va	0	1
Rattus rattus (house rat)	Rr	0	4
Jungle fowl	-	1	0
Fish freshwater species unknown	-	0	1
Worked Bone	-	15	23
Charred bones	-	62	3

mainly in the Megalithic/ Iron Age settlement. Presence of deciduous teeth suggests the killing of pigs at an younger age for dietary reasons. Occurance of both domestic and wild pig bones at the site has indicated their importance in the diet of the site inhabitants. Pig bones have also been reported from other Iron Age sites such as Bhagimohari, Naikund and Adam (Thomas 1993b).

Horse *(Equus caballus)* remains were earlier reported from the Deo's excavations at Mahurjhari only in association with burials (Rao 1973). These comprised mostly teeth, phalanges and limb bones. Frequent occurrence of teeth from some of the burials has helped in finding out the sex and age at which the animals died. The presence of 'tush' in the teeth of *Equus caballus* suggested it to be a male horse (Rao 1973). By studying the crown pattern and wearing on the horse teeth found in megalith no: 3 at Mahurjhari, the horse was identified as a stallion aged around 5-6 years old. While in megalithic no: 11, a mare aged about 4-5 years old was identified (Thomas 1992a).

In the 2001-2004 excavations none of the burials that were excavated yielded any horse remains. While only three bones comprising first, second and third phalanx were recovered from the Iron Age settlement (Fig. 6 and 7). It is rather intriguing that bone representation of this particular animal is very limited as against the rich presence of cultural material associated with it like horse bits, head ornaments, etc.

The presence of partial skeletal elements of horse is attributed to the selective burial by the megalithic inhabitants suggesting a ritualistic or sacrificial element. The occurance of horse remains along with horse ornaments, bits, etc. has strongly indicated its importance both as a means of transport as well as having considerable socio-cultural significance in the Iron Age culture of Vidarbha. One interesting aspect of the burials is the presence of copper head

Table 4: List of Molluscs found at Mahurjhari

Species	BV/G	FW/M/T	MEG/IA	EH
Lamellidens marginallis	BV	FW	24	46
Bellamya bengalensis	G	FW	1	11
Melania striatella	G	FW	-	4
Corbicula sp.	BV	FW	-	1
Pila sp.	G	FW	1	-
Lymnaea sp.	G	FW		2
Turbinella pyrum	G	M	2	7
Cypraea sp.	G	M	-	3
Moneta moneta	G	M	-	12
Oliva sp.	G	M	-	1
Nerita sp.	G	M	-	1
Unidentified BVfrg.	FW		5	2
Unidentified gastropod frg.	FW		-	2

BV-bivalve, G-gastropod, FW-freshwater, M-marine, T-terristrial MEG/IA: Megalithic/Iron Age; EH: Early Historical

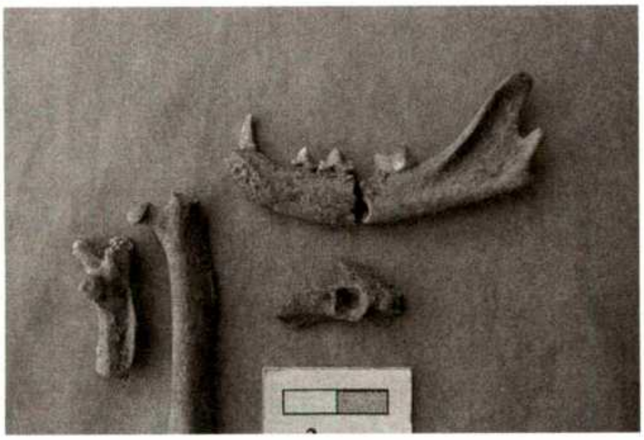

Fig. 8: bones of domestic cat (*Felis catus*)

ornaments that were worn by horses. These were found associated with specific horse burials at Raipur, Naikund, Takalghat-Khapa and Mahurjhari. This in a way suggests the important status of both the rider and the horse.

Dog (*Canis familiaris*) is represented by teeth, parts of mandible and long bones in both the periods. Its bones were recovered more from the Iron Age settlement MS-Tr. A and B as compared to the Early Historical settlement. Some of the bones show complete charring and are with cut marks. It is quite possible that dog meat was consumed as is done by certain present-day communities like the Nagas in the north east. Evidence for use of dog meat as food is available from the Late Jorwe levels at Inamgaon (Thomas 1988).

A few bones of the domestic cat *(Felis catus)* were found only in the Early Historical settlement comprising fragments from the mandible, pelvis and femur (Fig. 8). Their isolated occurrence probably suggests that they were accidentally incorporated into the deposit.

Wild mammals In the entire assemblage, bones belonging to wild fauna are less as compared to those of the domestic cattle or sheep/goat. Their overall representation was more in the Iron Age than in the Early Historical period. These are represented by mostly teeth, mandibles, maxillae, phalanges, pelvis and long bones. Many of these bones display cut marks and are charred indicating that these too along with domestic animals had been consumed as food. Presence of meat-bearing parts suggests that after hunting the animals were brought to the settlement where meat processing was carried out. The hunting of young animals is apparent from the occurance of deciduous teeth and teeth wearing pattern.

A few isolated bones of the spotted deer (*Axis axis)* and blackbuck (*Antilope cervicapra)* (Fig. 9), were found in both the periods. The bones of the blackbuck (*Antilope cervicapra)* were more in the Iron Age as compared to Early Historical levels. While the spotted deer Chital (*Axis axis)* represented by teeth, parts of the mandible, pelvis and tibia was more common during the Early Historical levels. A shaft from the humerus and a third phalanx belonging to nilgai (*Boselaphus tragocamelus*) were recovered only from the Megalithic/Iron Age levels

Table 5: Teeth Measurements (in mm) from Mahurjhari

Sr. No.	Trench	Dig	Depth (cm)	SP	Tooth	Length	Width	Remarks
2	MS-A	5	111-113	Ch	M1/M2	21.26	14.55	Just erupting
13	MS-A	0-15	B/B	M1/M2	26.70	50.47	Max.	
14	MS-A	0-15	B/B	M1/M2	23.53	15.58		
16	MS-A	15-19	B/B	m1/m2	13.98	5.96		Man, just erupting, slightly charred
58	TRB	9	55-60.	BI	M1/M2	16.66	23.11	max
59	Tr B	9	55-60	BI	M1/M2	13.24	28. 54	Max, just erupting
62	Tr.C	13	90-95	BI	p2	19.17	15.06	Man.
79	Tr.F	Lot	611, 11	51-53	BI	m1/m2	53.11	26.29 Man
81	Tr.F	7,	33-37	Ch	m1/m2	--	11.95	-
304	MS-A	21	64-68	Ch	M1/M2	14.77	11.47	Max.
305	MS-A	18	57-59	B/B	In	12.40	8.97	
308	MS-A	Lot	025	82-84	B/B	m1/m2	24.30	24.60
120	Tr.F	21	54-67	BI	Man-con	-	26.56	Condoyle
336	Tr.B	Lot	4111	Sd 46	BI	m1/m2	13.26	54.09

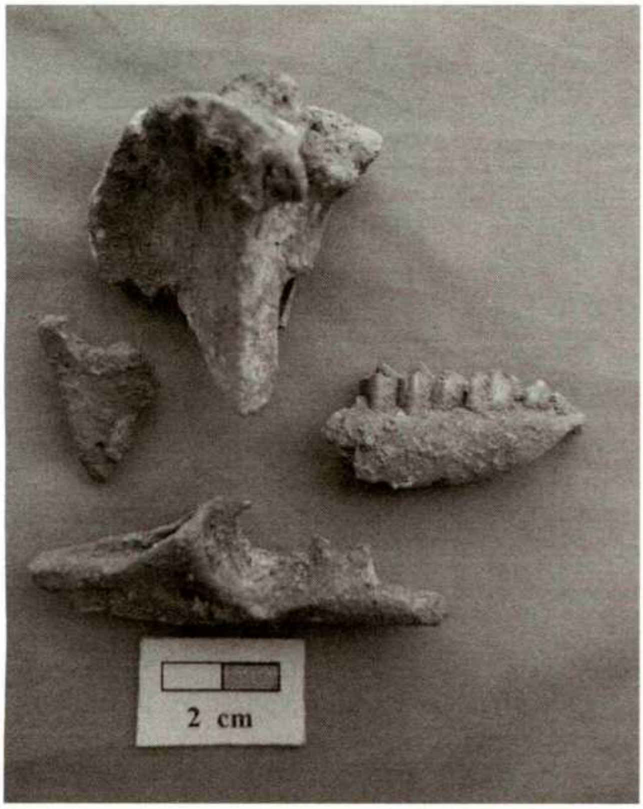

Fig. 9: Proximal part of tibia, third phalanx, pelvis and part of mandible of *Antilope cervicapra*

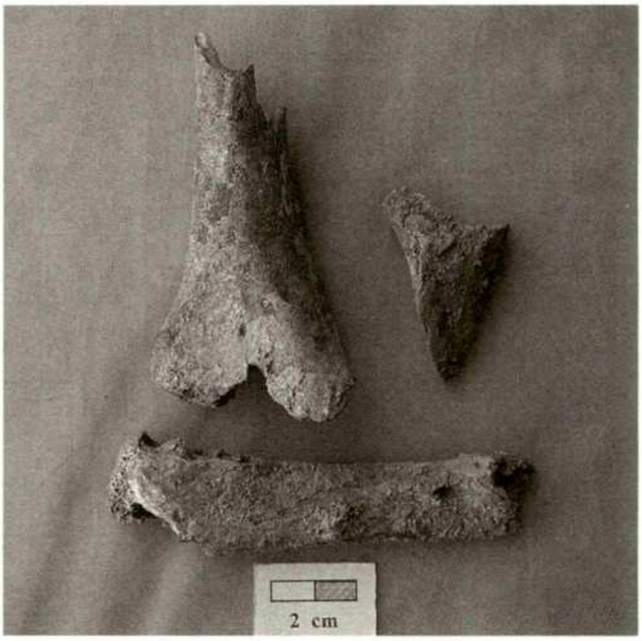

Fig. 10: Shaft fragment from humerus of Nilgai (*Boselaphas tragocamelus*)

(Fig. 10). Interestingly the nilgai is not reported from other Iron Age settlements in the Vidarbha region except from the Iron Age levels at Adam III (Joglekar and Thomas 1997-1998; Thomas *et al.* in press). The remains of the wild pig (*Sus scrofa)* (Fig. 11 and 12) along with those of the chowsinga (*Tetracerus quadricornis)* (Fig. 13) were also found only in the Iron Age settlement MHR MS-A and B.

From the same settlement two fragments from the mandible of a leopard (*Panthera pardus)* showing charring (Fig. 14) and a proximal portion of the ulna and a canine tooth of the wolf (*Canis lupus)* were identified (Fig. 15). However on the basis of their isolated appearance it is difficult to determine whether these had also been hunted along with other wild fauna for dietary reasons or were naturally deposited.

Table 6: Measurements of forelimb bones from Mahurjhari : Radius (RA)/Ulna (UL), Humerus (HU) and Metacarpal (MC).

Sr. No.	Trench	Dig	Depth(cm)	SP	BN	BP	Width of head	Sd	BD (trochlea width)
60	B	8	50-55	BI	HU	-	-	-	65.92
78	Tr.F	Lot 632	113	Cf.	RA	16.41	-	-	-
121	MsA	Lot 26	85-94	C/O	Hu		-	15.26	-
321	Tr.B	Lot 4209	Sd.35	Ac	RA	30.02	-		-
50	MsA	15	183-145	BB	MC	-	-	42.30	60.80
338	MS-A	Lot 402	9-12	S/O	RA	-	-		28.21
339	MS-A	Lot 429	73-74	BI	MC	-	-	27.72	40.18

Table 7: Measurements of hind limb bones from Mahurjhari : Femur (FE), Tibia (TI) and Metatarsal (MT),

Sr. No.	Trench	Dig	Depth (cm)	SP	Bn	BP	TP	SD	BD	TD
326	Tr.B	Lot4106	Sd 32	BI	TI	-	-	-	65.40	-
72	Tr.C	7	43-53	Ln	FE	-	-		16.87	-
1	MS-A	2	103-108	BI	TI	-	-	-	54.73	-
21	MS-A		34-35	Sd	TI	-	-	-	26.22	17.89
57	TRA	7	32-40	Cf.	TI	-	-	10.63	15.73	-
71	Tr.C	7	43-53	BI	TI	-	-	-	35.96	-
74	Tr.C	Lot 8	53-62	BI	TI	-	-		44.32	38,39
73	Tr.C	Lot 8	53-62	AC	TI	43.61	-	-	-	-
80	Tr.F	Lot 620	102-106	BI	TI	44.23	-	-	-	-
313	Tr.B	313	Sd 21	Sr	TI	-		12.66	21.08	16.24
337	Tr.B	Lot 4401	Sd 73	Tq	Fe	-	17.75	-	-	-

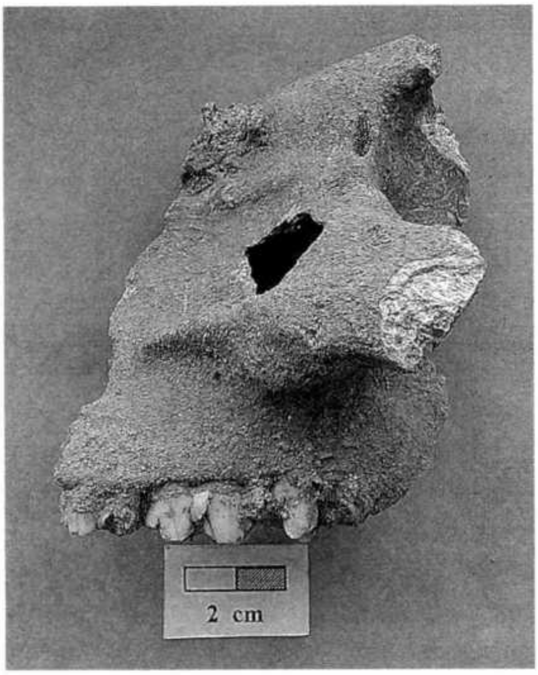

Fig. 11: Maxilla of wild pig (*Sus scrofa*)

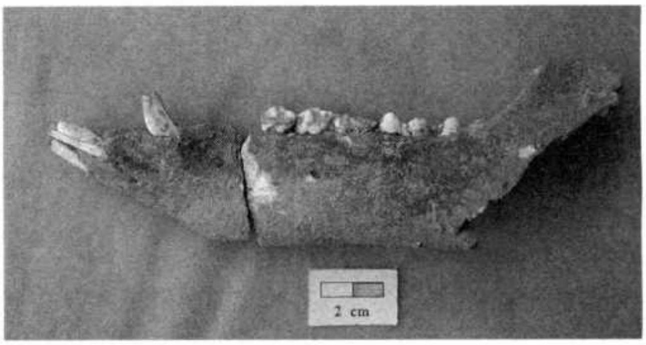

Fig. 12: Mandible of wild pig (*Sus scrofa*)

Bones of the small mammals like the hare (*Lepus nigricollis*), rat (*Rattus rattus*), and a vertebra of the monitor lizard (*Varanus* sp.) were observed in the Early Historical settlement. These burrowing animals are generally found living in the vicinity of human settlements. Some like the hare could have been caught for food purposes. The mongoose (*Herpestes edwardsi*) identified by a lower jaw was found only in the Iron Age settlement. This animal eventhough wild is often found associated with human dwellings and could have been naturally incorporated into the deposit.

A few bird bones are reported from both the periods in very fragmentary condition, mostly comprising long bone fragments. Hence it was difficult to carry out specific species identification. The bones were in the size range of the domestic fowl

Table 8: Astragalus Measurements from Mahurjhari

Sr. No.	Trench	dig	D Depth (cm)	SP	GLl	GLm	BD
70	Tr.C	07	43-53	BI	56.72	56.27	35.41
77	Tr.C	11	76-83	BI	58.35	54.77	37.68

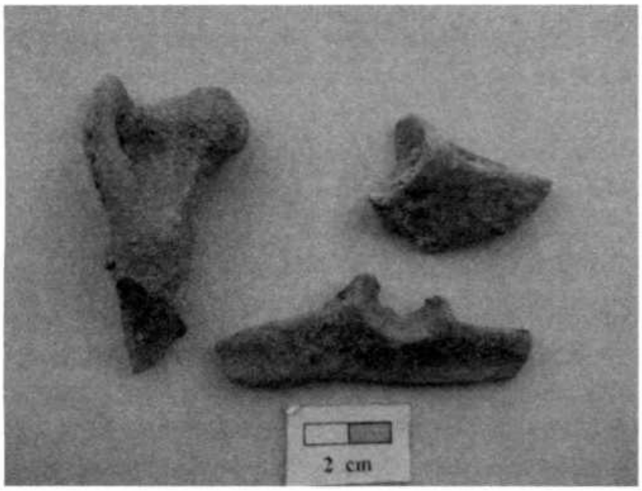

Fig. 13: Proximal part of femur and fragments from pelvis of *Tetracerus quadricornis*

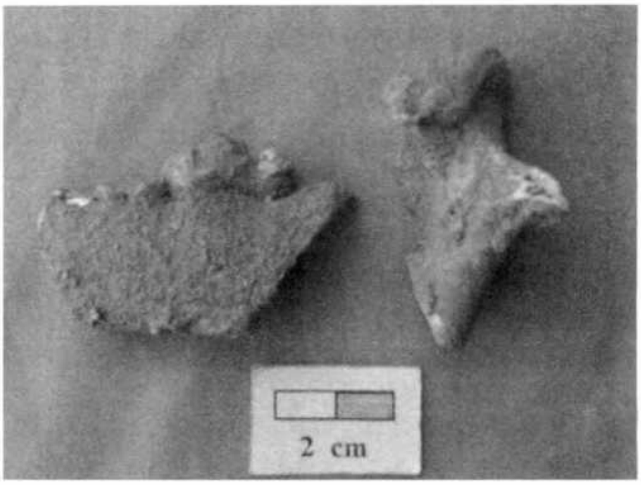

Fig. 14: Mandible of *Panthera pardus*

and are therefore tentatively identified as the domestic chicken *(Gallus domesticus).* A shaft fragment belonging to the jungle fowl (*Gallus gallus*) was recovered from the Iron Age settlement.

Fish and Molluscs at Mahurjhari

In case of aquatic animals, only molluscan shells were recovered in both the periods while a single fish spine was obtained from the Early Historical habitation. A near absence of the Fish is attributed to retrieval methods as well as poor preservation. Fish bones in general due to their small size and fragile condition are often not well preserved hence are generally poorly represented at many Indian sites. At Mahurjhari no freshwater turtle remains are identified but have been reported from other Iron Age levels at Bhagimohari and Adam (Table 2).

The molluscs showed better preservation and occured as partially broken to fragmented shells in both the periods. A total of six freshwater and five marine were identified (Table 4). Among the freshwater molluscs, the freshwater bivalve (*Lamellidens marginallis)* is most common and was found at the Iron Age and Early Historic settlement. Other freshwater gastropods present are *Bellamya bengalensis, Pila sp., Melania striatella,* and *Lymnaea* sp. which occur only in the Early Historical habitation. Some like the *Lamellidens* were brought specifically to the site for food purposes from the Iron Age onwards. During the Early Historical period use of this particular shell was made in shell working as observed from the abraded and cut edges of the shell fragments (Fig. 16). These could have been used as inlays. While freshwater gastropods such as *Melania striatella* and *Lymnaea* which are small in size having no food or any ornamental value were probably introduced accidentally. These might have been brought along with riverine sand and mud brought for construction purposes.

Presence of marine molluscs such as the money cowrie *Moneta moneta, Nerita and Oliva sp.* is noted mainly from the Early Historical settlement. These small marine gastropods are commonly found along the Indian west coast. It is a little difficult at this juncture to account for their presence at Mahurjhari as these occur as isolated finds. However, their marine origins and occuarance in the interiors of the Vidarbha region makes them interesting. At Mahurjhari a single *Oliva* shell perforated at the apex was found. *Oliva* shells have been identified from other Early historic sites in Vidarbha such as Kaundiyapur and Paunar

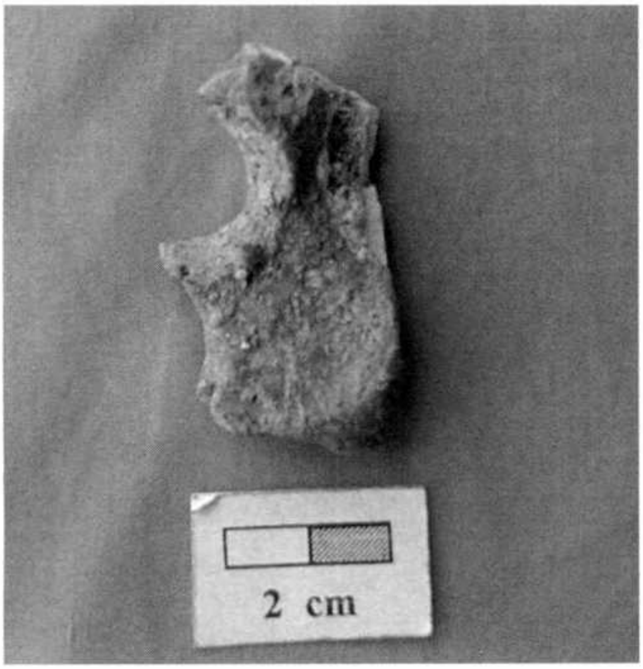

Fig. 15: Proximal ulna of wolf (*Canis lupus*)

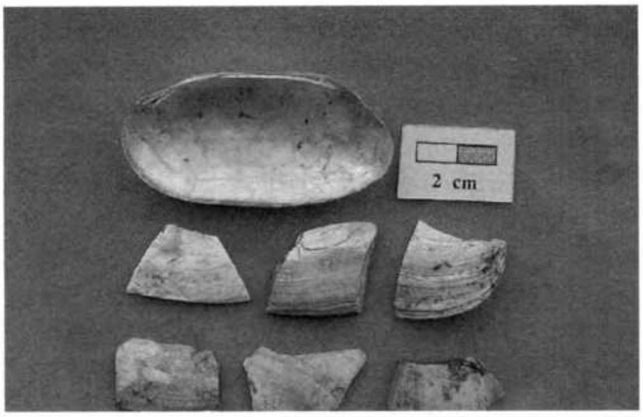

Fig. 16: Cut *Lamellidens* shell fragments

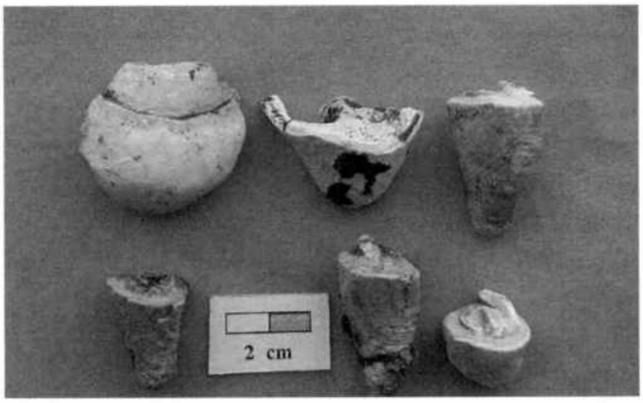

Fig. 17: *Turbinella pyrum* columella fragments

(Deshpande-Mukherjee 2006-7) and recently at Bhon (personal observation). Similar shells were also commonly found associated with certain Chalcolithic and Early Historic sites mainly in the Western Deccan such as Inamgaon, Navdatoli, Nevasa (Deshpande-Mukherjee 2005, 2008).

Even though the cowrie (*Cypraea arabica)* is reported from the Iron age levels at Khairwada (Thomas 1993a) presence of the money cowrie (*Moneta moneta*) is noted only in the Early Historic levels at Mahurjhari. From the same period certain cowrie shells due to their fragmentary condition and discolouration were identified as *Cypraea* sp.

At Mahurjhari use of the large marine gastropod *Turbinella pyrum* is well attested in the Early Historic period by the presence of shell bangles and beads. No sawn fragments from its main shell whorl were observed, yet occurance of a few sawn columellae does hint at some amount of shell working (Fig.17). This was probably first introduced during the Iron Age as part of a columella was found in the Iron Age settlement. However in this region besides Khairwada, shell evidence from other sites shows its general absence in the megalithic levels but making an appearance mainly during the Early Historical period. During this period in the Deccan region, *T. pyrum* columellas were specifically used for making beads and other miscellaneous objects (Deshpande-Mukherjee 2008). A cylindrical bead made from the *T. pyrum* columella was observed at the recently excavated site of Kalahali Brahmapuri in Nagpur district (personal observation). The overall presence of marine shells is indicative of long distance trade and complex trade networks during the Early Historical period in the Vidarbha region.

Bone Tools

In both the periods an appreciable number of modified bones were encountered (Fig. 18). These were mostly long bone fragments and ribs whose edges were abraded and polished to be used as tools. Certain bone splinters were shaped into points. Use of fire for hardening the tips is visible on some of the bones. The manufacture of bone tools had probably resulted in the large-scale bone fragmentation at Mahurjhari. This activity appears to be more

Table 9: Measurement of I, II and III Phalanges from Mahurjhari

Sr. No.	trench	dig	Depth (cm)	SP	Ph	GL	BP	TP	BD
6	MS-A	6	180-190	BI	III	-	40.84	23.26	-
7	MS-A	6	180-190	BI	II	-	-30.24	34.14	-
54	B	7	45-50	BT	III	44.72	-	—	-
301	MS-A	—	53-57	BI	II	37.44	29.64	29.84	26.59
302	MS-A	—	53-57	BI	I	54.98			
309	MS-A	Lot 019	59-62	BI	II		30.42	32.25	26.47
306	MS-A	Lot 025	82-84	BI	I	48.91	25.23	-	23.30
307	MS-A	Lot025	82-84	Ec	III	-	-	-	62.25
	MS-A	surface		Ec	I	78.70	56.94	-	44.37
311	MS-A	026	85-94	Ec	II	38.66	45.37	-	42.95
312	Tr.B		39	BI	II	41.86	30.70	-	30.34
318	Tr.B	Lot4210	Sd 40	Ac	III	27.41	10.27	-	
325	Tr.B		Sd. 40	Cf.	I	20.34	6.94	-	5.92
316	Tr.B	Lot4210	Sd. 40	BI	II	37.02	25.45	-	22.45
317	Tr.B	Lot4210	Sd. 40	BI	I		26.46	-	
319	Tr.B	Lot4209	Sd.35	BI	III	60.80	22.09	-	
320	Tr.B	Lot4209	Sd.35	BI	I	-	-	-	24.45
328	Tr.B	Lot4114	Sd 60	BI	I	-	-	-	30.41
329	Tr.B	Lot4114	Sd 60	BI	I	-	-	-	27.87
335	Tr.B	Lot4111	Sd.46	BI	III	67.67	22.91	-	

prevalent in the Early Historical period where they were used in various craft related activities like hide preparation, bead manufacture and also for domestic use. From this period, two bone artefacts made from the shaft of the long bones were found. One is shaped like a spatula and has many small circular depressions made on the inner side while the outer surface is well polished (Fig. 19). The other comprises a part of the long bone shaft split lengthwise with similar depressions on the inner surface and having an outer polished surface (Fig. 19). These might have been used for holding beads while perforating them using drills.

Discussion

The analysis of animal remains recovered from the Iron Age and Early Historical settlement at Mahurjhari has given sufficient insight into the exploitation of various animals through out its occupation. Beginning with the Iron Age period, the settlement saw the maximum use of cattle as food, for obtaining dairy products, in agricultural activities, etc. This feature has been observed at other sites as well such as Bhagimohari, Adam, etc. Besides cattle, sheep/goat had also contributed significantly to the diet. Presence of a large number of cattle and sheep/goat bones indicates the reliance of the inhabitants on these particular animals. Occurrence of pigs and domestic fowl show the stocking of smaller animals for purely dietary reasons as well. Animals were killed at a young age as seen from the teeth eruption pattern. The bone evidence has also helped to show the sedentary nature as well as give a rough estimate of the size of the settlement occupied from the Iron Age onwards. Since cattle herds and horses in particular require proper maintenance, the settlement had to be fairly large and well equipped with adequate shelter and penning facilities.

The domestic horse (*Equus caballus)* although poorly represented in the Iron Age habitation area, its presence in the burials along with associated cultural material such as horse ornaments, bits, etc. in a way reflects its importance as a high-status animal during the Iron Age at Mahurjhari. Presence of dog and cat bones suggests their close association with the site inhabitants as that of pets, guard dogs or as scavengers.

Regarding the occurrence of wild mammals such as spotted deer, chowsingha, blackbuck, nilgai,

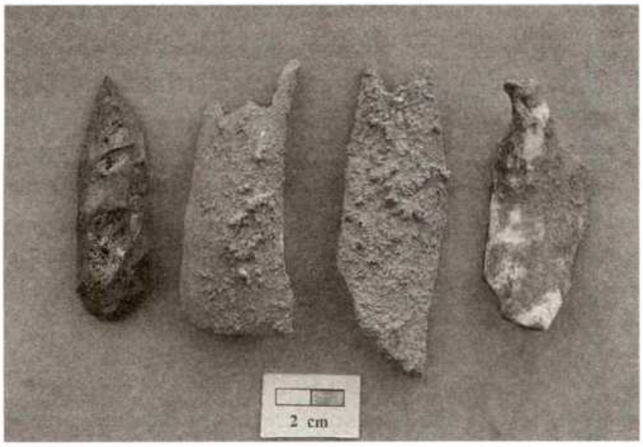

Fig. 18: Bone tools

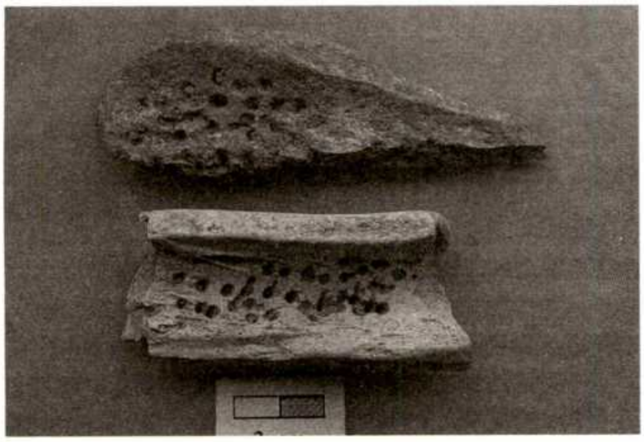

Fig. 19: Bone tools used during bead making

wild pig, etc. these were occasionally hunted as seen from the few bones with cut marks. The chital or the spotted deer (*Axis axis*) was more commonly hunted as compared to other wild animals. However, frequency of hunting wild animals decreases considerably in the Early Historical period. Hunting probably by the Early Historical period might have been restricted to certain sections of the society, hence their isolated representation. Evidence of the carnivores such as the wolf (*Canis lupus*) and leopard (*Panthera pardus*) reveals the presence of these predators in the vicinity of Mahurjhari. Both animals are known to attack goats, sheep and fowl during the night.

The general presence of the wild fauna at Mahurjhari has in a way helped to reconstruct the ecological conditions prevalent around the site during the Iron Age and later periods. A tree-covered landscape with plenty of grass cover interspersed with water bodies during the rainy season is proposed. Animals like chowsingha (*Tetracerus qaudricornis)* are generally found close to water bodies. So are the deer and wild pigs. Representation of the latter at most of the sites in this region suggests the wet humid condition exhisting at that time.

At Mahurjhari although there is no major river in its vicinity, the inhabitants were procuring freshwater mussels probably as a food source and later to be used in shell working. Use of discarded animal bones after meat removal for the manufacture of bone tools and molluscan shells in shell working has revealed the diverse ways in which animals were used. Both these industries achieved prominence in the Early Historical period however, their early beginnings were already made during the Iron Age. In this period presence of modified bones suggests this particular activity. These were mostly made on long bone fragments. Whereas shell working developed mainly during the Early Historic period. The bead making industry might have helped the shell industry to flourish as well.

In both the periods a more or less similar nature of faunal exploitation pattern is observed without any major changes. This in a way reveals the continuity in the occupation of the site from the Iron age to the Early Historical period. No significant changes in the local environmental conditions had taken place to bring out major shifts in the subsistence economy. The nature of faunal exploitation is also quite similar to that observed at other Iron Age settlements in the Vidarbha region. To conclude the faunal evidence from Mahurjhari has revealed the Iron Age economy as a combination of farming, stock rearing and hunting, with a lot of emphasis on cattle pastoralism that continued into the later period. It is probably during this period that the initial foundations for the growth of Mahurjhari into a full-fledged agricultural settlement were laid. In the succeeding Early Historical period, the rich agriculture based economy with its stock rearing and animal-herding practices might have been responsible for its development into an important bead-manufacturing centre in the Vidarbha region.

Abbreviations

SP- Species, BN-Bone, Max.- Maxilla;
Man- Mandible; Man-teeth Mandibular teeth;
Max-teeth Maxillary teeth; I-Incisor; C-canine;
M1/M2-maxillary molar, m1/m2–mandibular molar,
Sc-Scapula; Hu-Humerus; Ra – Radius;
Ul- Ulna, Mc-Metacarpal; Mt - Metatarsal;
PV-Il- Pelvis Ilium; PV-Is- Pelvis Ischium,
PV-Pb- Pelvis Pubis; Fe-Femur; Ti-Tibia;
As-Astragalus; Ca-Calcaneum
Ct-Centrotarsal; Ph I- first Phalange;
PhII- Second Phalange; PHII- Third Phalange;
RI-Ribs; VB-Vertebrae; At- Atlas; Ax-Axis;
TV-Thorasic; LV-Lumbar; CV-Cervical;
L.bone-Longbone; Uf- Unidentified–s-small,
m- medium, l-large; Portion: P-proximal;
I-Intermediate; D-distal; Side: L-left R-right;
I- intermediate; Fusion : F-fused; U-unfused,
Bp-proximal width; Bd- distal width;
Td- distal thickness, Tp- proximal thickness.
Sd-width of shaft, Gl- greater length,
GLL-greater length of lateral half;
GLm-greatest length of the medial half;
Ht.- height, Bt.- breadth.

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A Study of Glass Bangles from Abhaipur, District Pilibhit, Uttar Pradesh

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Abstract

Though glass bangles are reported right from the Painted Grey Ware (PGW) Period in the Ganga Valley, rampant use of glass bangles begins only in the Northern Black Polished Ware (NBPW) period in north India. There are a number of excavation reports, which provide evidence of glass bangles in stratified context. However, none of these emphasizes the typo-technological evolution of bangles. The present examines glass bangles of PGW and NBPW periods obtained from excavations at Abhaipur.

Introduction

Bangles of terracotta, faience, shell, turtle carapace and copper/bronze and gold have been found from Neolithic/Chalcolithic sites in India. It seems that women were more fond of bangles than their counterparts during the Harappan civilization (e.g. the dancing girl of Mohenjo-daro and terracotta figurines). The same may also be noted in the paintings of Ajanta, Bagh and other caves, or the sculptures from Barhut, Sanchi, Mathura, Amaravati and Nagarjunakonda (Sankalia 1977:229, for details see Tiwari 1992:135-159). Hala who composed the *Gathasaptasati* also refers to bangle (Sanskrit *valaya*) as a symbol of femininity (Sankalia 1977:228-229). It also characterised the married status for a Hindu woman (*suhagan*), particularly bangles of shell and red bangles (*shankha*) made of *lac* or China clay, and symbolised that her husband was alive. Bangles are removed once a woman becomes widow. Until recently, a Hindu bride was blessed with bangles thought to be as powerful as *Vajra* (the weapon of god Indra) to protect her.

Previous Studies on Glass Bangles

The antiquity of glass bangles does not go beyond Painted Grey Ware (PGW) Period in north India or the beginning of Iron Age in the Ganga Valley. Only four sites, Hastinapura, Bhagwanpura, Ropar and Abhaipur have so far yielded glass bangles in PGW period. The abundant use of glass bangles begins only in the Northern Black Polished Ware (NBPW) period. In the Ganga Valley, excavated sites like Hastinapura (District Meerut) and Atranjikhera (District Etah) yielded an extremely limited number of glass bangles in the NBPW Period.

It should be mentioned here that in India so far more than 210 sites have been reported with findings of glass objects (Kanungo 2004). Research on glass in India are based on the antiquity and origin of glass, typo-technology of glass beads and glass bead making in the ancient India and spread of glass technology (Dikshit 1969; Brill 1987; Kanungo 2004). Detailed studies of glass bangles are limited. Scientific analysis of a few glass objects from different sites of Uttar Pradesh is given below, which are important in the point of view of present paper. Table 1 provides a comparative study of colours of glass bangles found from different sites.

Though B.B. Lal mentions the occurrence of glass bangles in large numbers at Hastinapura, he reports only two bangles from the PGW Period and none from the NBPW Period. Of these two, one is light brown in colour with triangular cross section, and the other is rectangular in cross section. No colour is mentioned in the latter case. The remaining bangles reportedly belong to the 11th -15th century A.D. (Period V). These comprise monochrome, bichrome and polychrome bangles and of both opaque and translucent varieties. The common colours are white, yellow, blue, light brown, black and green. Stratified bangle specimens are common in this period (Lal 1954-55: 90-91).

At Atranjikhera, R.C. Gaur (1983) reports only three fragments of glass bangles in the NBPW Period.

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These are green, brown and blue in colour. The first one is triangular in cross-section and has a single row of yellow studs round the outer edge. The rest are semicircular in cross-section. Four glass bangle fragments have been reported from the NBPW period of the site of Anai, located 35 km northwest of Varanasi (Tripathi and Upadhayay 2005-06: 96). However, further details are not available. Kopia (District Sant Kabir Nagar, U.P.), believed to be a glass manufacturing centre, has been recently re-excavated (2004-06). Kanungo (2005-06: 111), the excavator reports 19 glass bangle pieces belonging to the Sunga-Kushana Period, however, he does not mention colour, size, shape and cross section.

A total of nine pieces of glass bangles have been found at Bhagwanpura from the middle level of Period Ib which represents an overlap of Late Harappa and PGW cultures. Both translucent and opaque varieties of bangles have been noted. The colour combinations of bangles are - blue with a silver colour coating, black with a silver and golden lustre and white with a silver coating. All bangles except one (convex) have triangular cross section. The diameter of bangles ranges from 2.35 to 5.5 cm (Joshi 1993: 124-25).

At Ahar, four fragments of monochrome glass bangles have been reported. Two of these were found from the last Phase (Ic) of the Chalcolithic Period and the other two were collected from the surface. The bangles are turquoise blue, sea green and milky white in colour and are translucent. While one is plano-convex in cross-section, the other is triangular. According to Sankalia (1969:204) "... as the horizons of Period Ic was very much disturbed, it is more likely that the bangle fragments belong to Period (II) rather than Phase Ic". Nonetheless, since Period IIa at Ahar coincides with the NBPW Period, these bangles would not be later than the date of this culture.

Marshall's observations (1975) on glass bangles of Taxila are extremely valuable. Glass bangles occur at Taxila in the earliest stratum of Bhir mound, i.e., about 500 B.C. Black glass, which looks like obsidian, seems to have been manufactured at a very early period. Bangles of sea-green glass make their appearance in the Bhir mound by about 400 B.C. Other colours are amber, violet, black and yellow. The favourite colour from the beginning to end was blue and shades from pale to dark; some produced from metallic copper, others from cobalt. A few have a narrow strip of white on blue running like midrib round the outer face (Marshall 1975: 683-84). The bangles from the early level of Bhir mound are plano-convex or plano-conical in section but narrower in proportion to their thicknesses. The colours are blue, green and black. The common type of shape is circular (average diameter: 3 to 6 cm, width 9 mm and thickness 5 mm).

Chemical Study of Glass Bangles

Chemical analysis of glass bangles of Bhagwanpura carried out by B.N. Tandon (Joshi 1993: 219-222) revealed that blue glasses contained copper and black glasses zinc, while iron was found in both. The glass was made by combining naturally occurring inorganic materials and heating to fusion so as to form a consolidated mass. The energy dispersive fluorescence analysis of black bangles has revealed high percentage of loss in ignition (12.6%) due to organic depositions during the long burial in the soil. SiO_2 (57.56%) and R_2O_3 (9.43%) comprised the acidic group. The alkalis formed 14.72% along with CaO 4.13% and MgO 1.56%. While nickel, cobalt and manganese were absent, zinc was found in traces. The high percentage of R_2O_3 was responsible for the specific colour of the glass. Absence of barium indicates that the glass does not have a Chinese origin. The density of the glass was calculated to 2.4. The specific gravity of the blue, green, black and yellow glass of Taxila ranges from 2.3 to 2.6, showing that there was little or no lead used in their composition (Marshall 1975: 684).

Scientific analysis of glass specimens, two each from Hastinapura (District Meerat, U.P.) and Ahichhatra (District Bareilly, U.P.); three specimens from earlier excavations at Kopia (District Sant Kabir Nagar, U.P.) have been carried out (Lal 1987; Ghosh 1989:322-324). Recently, the site of Kopia has been re-excavated and 16 fresh specimens have been analysed (Kanungo and Brill 2009:7-14). The summary of these analyses is given below.

The Hastinapura samples, brownish and black bangle fragments, have yielded ordinary soda-lime silicate containing a low amount of alumina (Al_2O_3) and silica (SiO_2), which make it soft and suitable for bangle making. The brownish colour comes from the presence of some amount of iron oxide and the black colour is due to its excessive presence. The specific gravity of these samples is respectively 2.55 and 2.6; and the hardness is about 6.

The Ahichhatra specimens, a blue glass and a green glass, of the first century have also yielded soda-lime silicate and a high proportion of lime and magnesia and a low content of the sesquioxides. The blue colour is due to presence of copper oxide and green for combination of copper oxide (Cu_2O) and lead oxide (PbO). The presence of lead is significant owing to its rareness in the 1st century.

The Kopia specimens are characterized by a low content of lime and magnesia and a high content of iron oxide (Fe_2O_3) and alumina (Al_2O_3). The colourlessness of a specimen is due to presence of low proportion of ferric oxide (2.5%) and manganese oxide (MnO, 0.1%); and the pale yellow colour is due to low concentration of iron and manganese (0.08%). The specific gravity of these samples ranges from 2.51 to 2.53.

The specimens collected from the recent excavations at Kopia have been studied with the help of the following methods, such as plasma spectroscopy, emission spectrography, X-ray diffraction and strontium isotope analyses. These specimens are divided into two groups; (a) 13 samples of soda-lime glasses having relatively low lime contents (=/<4% CaO) and high alumina contents (~4.5-6.5% Al2O3); and (b) three samples of potash-silica composition. The former group is similar to the earlier findings and latter group is more common in East Asia and Southeast Asia. So the latter specimens were not locally manufactured and could have been imported from outside (Kanungo and Brill 2009:7-14).

Interestingly, there are six bangle fragments included in the above analysis. Four of these are black; one transparent light blue and other one is yellowish green in colour. The cross-sections of black bangles are semicircular, rounded triangular and flat. The internal diameters of bangles fall into four sizes - 4, 6, 7 and 7.5 cm. Apart from these specimens, which have been listed but not scientifically studied include a blue and light blue bangles. Most of these bangles are taken from upper levels (1 and 2) and only two samples, one each from level 5 and level 6/7, are from the lower levels. No depth is mentioned for any of these specimens. The sample of level 5 (8422, reg. no. 387), a transparent light blue bangle with reddish surfaces in intervals, is one of the three potash-silica glasses.

From the earlier samples, a specimen with soda-potash-lime silicate is reported both from Rajghat and Nasik, while four specimens of Arikamedu represent potash-lime silicate characterized by high silica, low lime-magnesia and iron oxide alumina contents (Ghosh 1989:323). Thus, the above study has unravelled a new evidence of bangle imported from out side India, possibly from Southeast Asia.

From the above discussion, one can observe that most excavators have largely ignored the detailed study of glass bangles. The present paper, however, deals with an in-depth study of the glass bangles obtained from the excavations at Abhaipur.

Study of Glass Bangles from Abhaipur

Abhaipur is located on the right bank of river Deoha in Bisalpur *tehsil* of Pilibhit district, Uttar Pradesh. Considering the fast encroachments and the possibility of complete destruction of the site, the Department of Ancient History and Culture, M.J.P. Rohilkhand University, Bareilly, decided to begin to excavate the site to salvage as much evidence as possible in 2005-06 under the supervision[1] of U.P. Arora and Anup Mishra. The excavations were confined to the eastern periphery of the site due to large-scale encroachments and destruction in the central part of the mound.

Evidence of four cultural periods - Ochre Colour Ware (OCW), Black-and-Red Ware (BRW), Painted Grey Ware (PGW) and Northern Black Polished Ware (NBPW) were identified in the excavations. About 2.5 m (below datum) of habitation deposit divided into six distinct layers was found in the main trenches (E3 and F3) in the southeastern side. The stratigraphy is more or less identical in the northern part of site in trenches AX9, AX13, AX14, BX13 and BX14. However, on this side a thin layer (4) represented the BRW period, while the deposit of this period in trenches E3 and F3 is quite thick. A few pieces of ochre and OCW were also noted in the bottom of this layer. The matrix of layer (4) was almost identical with the underlying natural layer (5). Only the PGW and BRW cultures were represented substantially in all the trenches. The habitation area of the OCW culture remained elusive at the site and evidence for NBPW culture was meagre.

The Period IB (overlap of Late Harappa and PGW cultures) at Bhagwanpura has been dated to 1400 B.C. to 1000 B.C. on the basis of TL dates. This is so far the earliest dating of glass bangles in India. The PGW Period at Abhaipur has been dated to 1100 B.C. (cal.) on the basis of C14 dates. The lower date of Period II at Ahar is *c*.300 B.C. Therefore, the beginning of glass bangle use in India can safely be placed in the later half of the second millennium B.C.

A large number of glass bangle fragments were recovered from the PGW and NBPW Periods (280 bangle fragments collected in 2005-06 season). Besides, some bangle pieces were also collected during the previous seasons. Of these only seven pieces can be securely assigned to the PGW period (Figs. 1-4). All of these are black in colour, opaque, thin and triangular or semicircular in cross section. These have variable thickness (3-4 mm), 6 cm in diameter, and have horizontal scratch marks on the surface. The typology of glass bangles found from trench AX14 is given in (Fig. 5). This trench was most reliable in terms of preservation of the cultural material. However, the typological study of bangles has been carried out on the substantial collection made from another trench AX9 which has a thick NBPW deposit, but it could not be considered for stratigraphic representation of bangles as it was quite disturbed.

Glass bangles are found in two qualities, opaque (95%) and translucent (5%). The opaque variety is found in three types, namely monochrome (64%), bichrome (34%) and polychrome (2%). Stratified bangles are noted in bichrome and polychrome varieties (Fig. 6).

The monochrome type is found in four colours - black (54%), green (41% in different shades), blue (3%) and yellow (2%). The black and green varieties together constitute 95% of the bangles. The black bangles possess scratch marks and sometimes a hump on the middle of the outer surface. A number of colour combinations are noted in bichrome types (Fig. 7). In descending order of occurrence these are: red on green, brown on green, yellow on green, brown on black, green on red, yellow on brown, red on purple, green on brown, dark green on light green and black on brown. Only one fragment of a bichrome bangle with white on black combination is noted from another trench. The polychrome type, with the categories: yellow-brown-green, grey-green-light green, etc. are rarely encountered.

In cross section the bangles are semicircular (73%), rounded (9%), roughly triangular (8%), oval or semi-oval (5%), rectangular (3%) and square (2%). (Fig. 8). The bangles are not made perfectly circular. The width (2.5 to 8 mm) and thicknesses (2 to 4.5 mm) are also irregular. On the basis of diameter measurement, the bangles can be divided into six categories (Fig. 9).

Conclusion

Manufacturing technology and chemical composition of Abhaipur glass bangles have not been studied. In absence of evidence for glass manufacturing at the site, it can be assumed that the bangles were procured from other sites. It is not improbable that sites like Ahichchatra might have played a greater role in such activities. A lot of vitrified glass fragments are often collected from the surface of the site. The site of Kopia in Sant Kabir Nagar District of Uttar Pradesh is a well-known ancient glass manufacturing centre and might have dominated in the business in this region.

Stratigraphic study and distribution of bangles at the site indicate that their use started in the PGW Period. The black ones are found right from the beginning. These are irregular in shape, thickness and width, are opaque and their surface finishing is inferior in nature. The bichrome bangles and translucent varieties with smooth surfaces and even shapes and sizes indicate further development of manufacturing technology, and are probably of later date. However, the occurrence of all these types in the same context suggests that the bangles were procured

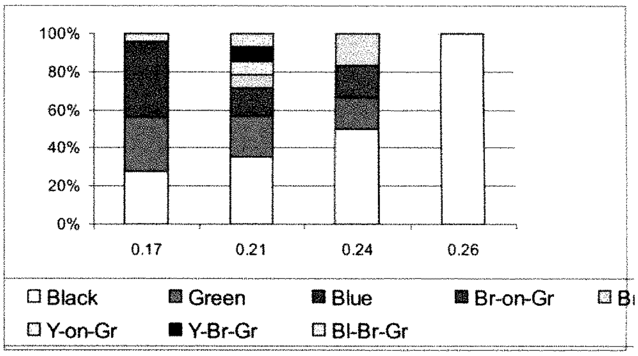

Fig. 5 Bangle types found in trench AX14

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1. The Department is grateful to Prof. R.K. Verma for his valuable guidance during the first season's excavations at Abhaipur.

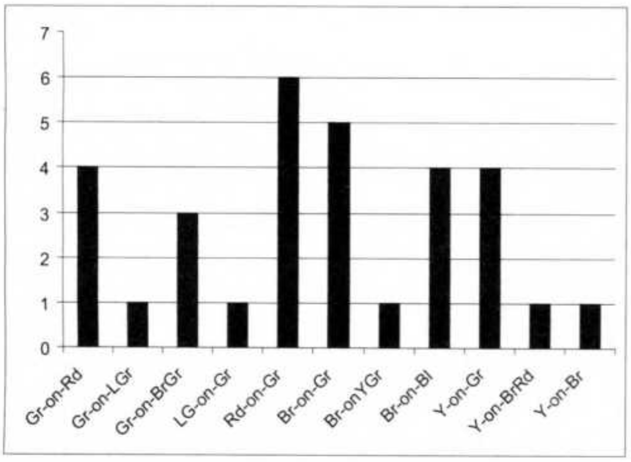

Fig. 6 Types of opaque bangle

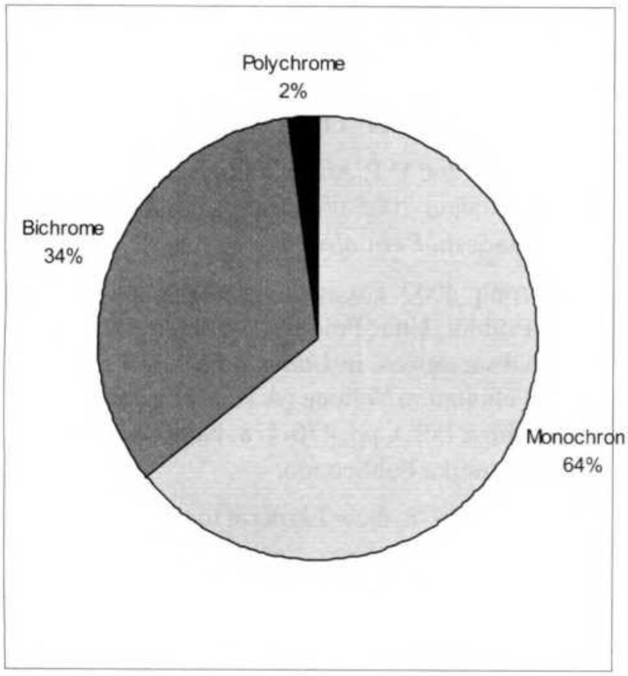

Fig. 7 Bichrome bangle types

from different places or different groups of artisans in the same time.

Polychrome bangles, though extremely limited in number, occur in the NBPW period. These comprise about 2-4% of the collection in different trenches. The colour combinations are yellow-brown-green, black-brown-green, brown-green-black, brown-yellow-green, yellow-green-brown, grey-green-light green and yellow-green-black. Ghosh (1989: 224) citing the evidence from Prakash, Ujjain and Yelleswaram opines that polychrome bangles came into vogue much later, i.e. end of the 1st millennium A.D. The late arrival of polychrome bangles in central and south India requires more studies.

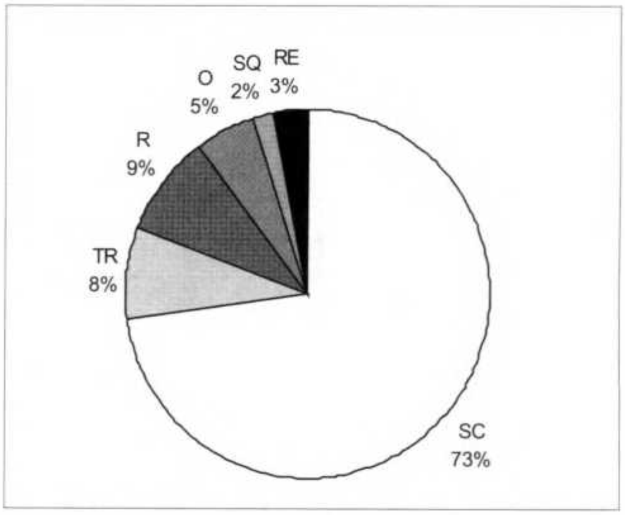

Fig. 8 Cross-section of bangles

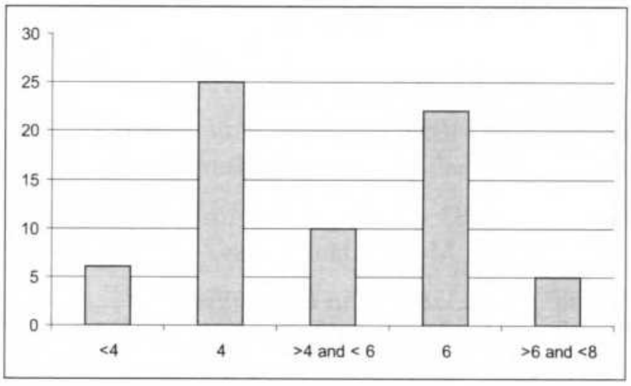

Fig. 9 Bangle diameter (in cm)

Six sizes of bangles are found at Abhaipur (diameter range: <4 to >6 cm). Joshi (1993) at Bhagawanpura has reported bangle sizes ranging from 2.35 to 5.5 cm (Joshi 1993). Marshall (1975: 684) has reported bangle sizes ranging from 3 to less than 6 cm. These coincide with the modern range of sizes. This probably indicates that glass bangles were worn by children as well as adults in the society. On the basis of categories or sizes of bangles, age groups or physical aspects of women may be enumerated. The bangle colours may be related to the social customs or beliefs and caste or folk groups during the NBPW Period, but this needs to be verified ethnographically.

Table 1: Colours/Colour combinations of glass bangles at PGW and NBPW sites

Sites/Colours	Black	Green	Blue	Brown	Yellow	Red	White	Grey	Amber	Violet/Purple
Abhaipur	☒	☒	☒	☒	☒	☒	☒	☒	X	☒ (Present)
Attranjikhera	X	☒	☒	☒	X	X	X	X	X	X (Absent)
Bhagwanpura	☒	X	☒	X	X	X	☒	X	X	X
Hastinapura	X	X	X	☒	X	X	X	X	X	X
Taxila	☒	X	☒	X	☒	X	☒	X	☒	☒
Ahar	X	☒	☒	X	X	X	☒	X	X	X

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Note on a Microlithic Site at Judwani, District Sonbhadra, Uttar Pradesh

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In the course of exploration in Sonbhadra district, Uttar Pradesh, we came across a microlithic site on a hill at Judwani (24° 22' 24" N; 83°02' 05" E) in village Gurmura (Fig. 1). We discovered an extensive quartz vein near Sonpahari in the village. Since gold occurs generally along with quartz vein, view of this, Sonpahari Hill at Judwani was identified as a prospective deposit of gold by the Geological Survey of India. There is a *nala* flowing nearby. In the bed of this *nala* hollowed out stones perhaps used as grinders for crushing ore were located by us during our previous trips. The *nala* is quite filled up with debris over a span of one year. On top of the hill nearby ancient gold mines are present.

While exploring the area for mining and metallurgical evidence, we found a platform on top of a nearby hillock. We were struck by thick debris of siliceous material consisting of quartz, quartzite, chalcedony, agate, jasper, etc. On closer examination of the scattered material, we discovered a microlithic factory site at three adjacent flat localities on the hill (Fig. 2). Quartz nodules scattered along with other workable stones are visible in the picture. Flat areas on top of the hill were selected as workshops. Workshop No. 2 is visible at the far end of the picture. The area is littered with quartz, quartzite, carnelian, chalcedony, agate and crystallized form of quartz as debitage. The workable material seems to have been brought from the nearby area.

At locality II, we came across an interesting evidence of a hearth/furnace-like structure with a hole probably used far inserting a tuyere. On the other side of the hole there is a clear trace of a burnt earth alignment which must have been a part of the

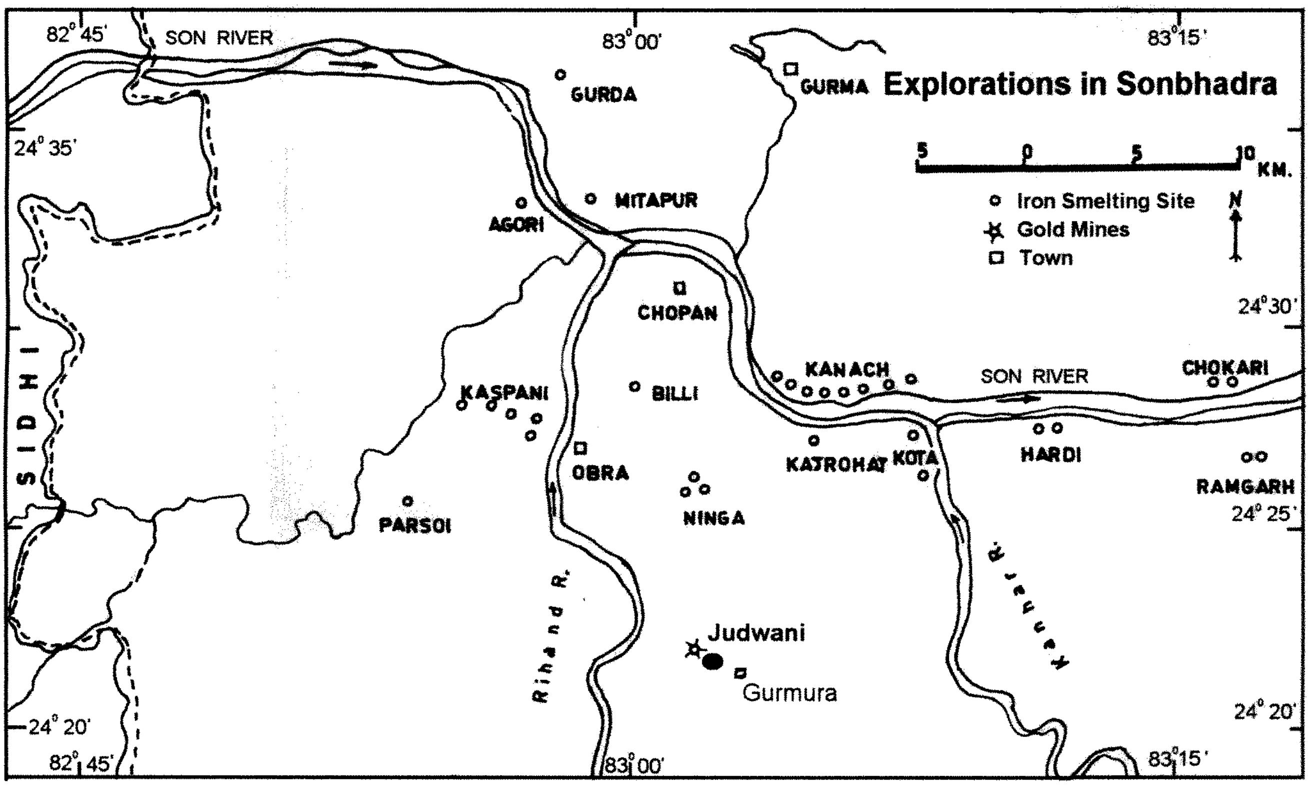

Fig. 1: Location map of the sites

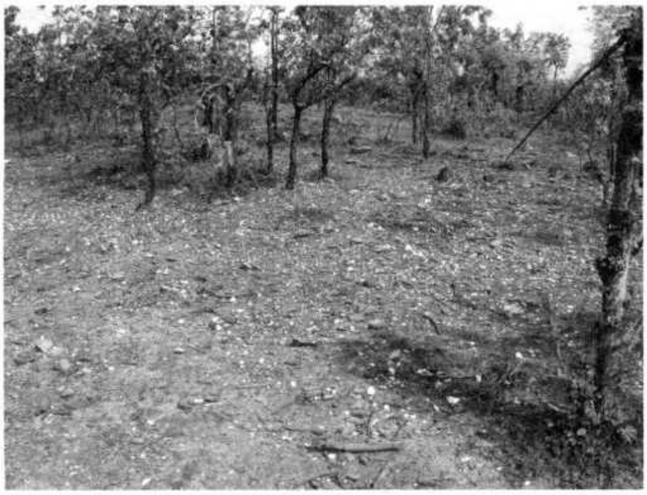

Fig. 2: General view of the working sites area (Locality I and II)

above mentioned hearth/furnace. Some slag pieces were collected in the vicinity. In association with this, grinding stones and hammers were also found. Another similar hearth/furnace with a tuyere hole is seen in locality III.

At locality III, the workshop is full of hammerstones and large grinding stones, many of which have been used for grinding. In the background other grinding stones are visible. At locality III the number of grinding stones and hammerstones was much larger. We observed a sizeable number of big stones broken due to excessive use. There are several types of hammerstones – round, ball-shaped, flat and worn out because of overuse (Fig. 3). Many these broken implements appear to have been discarded.

We could collect cores used for making tools from all the three localities (Fig. 4). The stones comprise quartz, quartzite, agate, chalcedony, jasper, carnelian, chert, etc. There are cores (size varies from 2 to 5 cm).

Microliths of different variety were collected from all the three localities. Their size varies from 1.5 to 4.5 cm (Fig. 5). The debitage is thickly scattered at the site and its distribution shows the site was used for manufacturing tools at all the three localities. However, microliths, cores and debitage were more thickly distributed in locality I.

The findings seem to point to multiple types of activities stretching over different periods. The

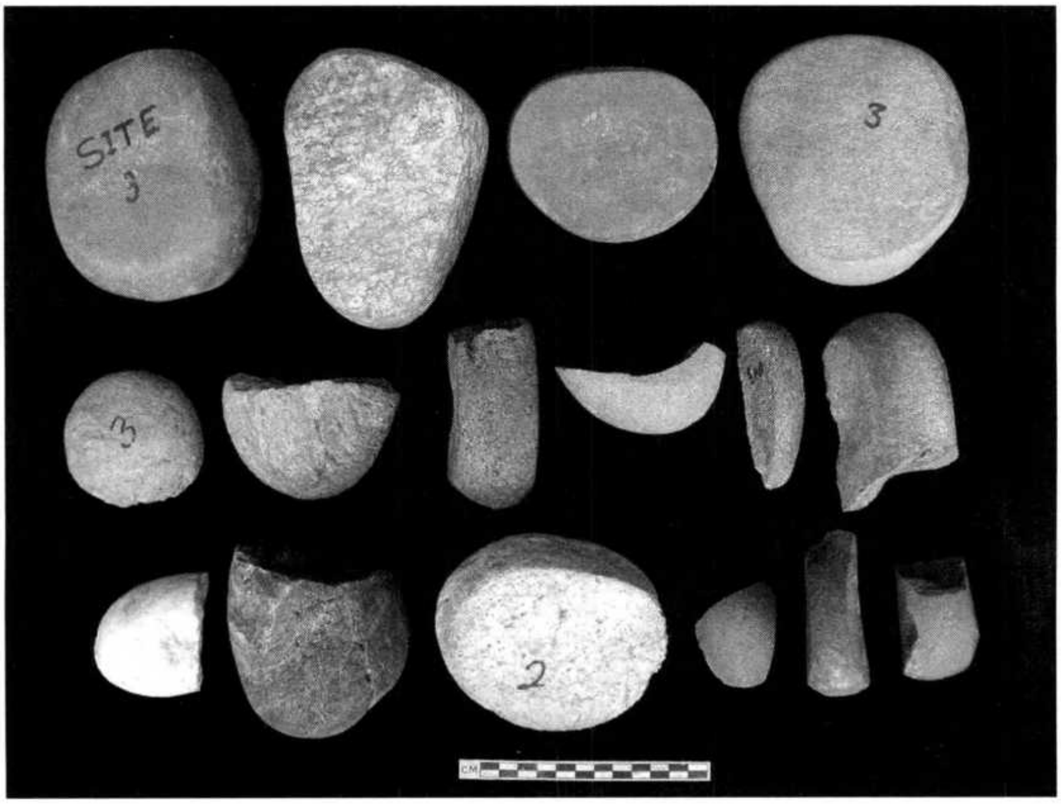

Fig. 3: Hammers

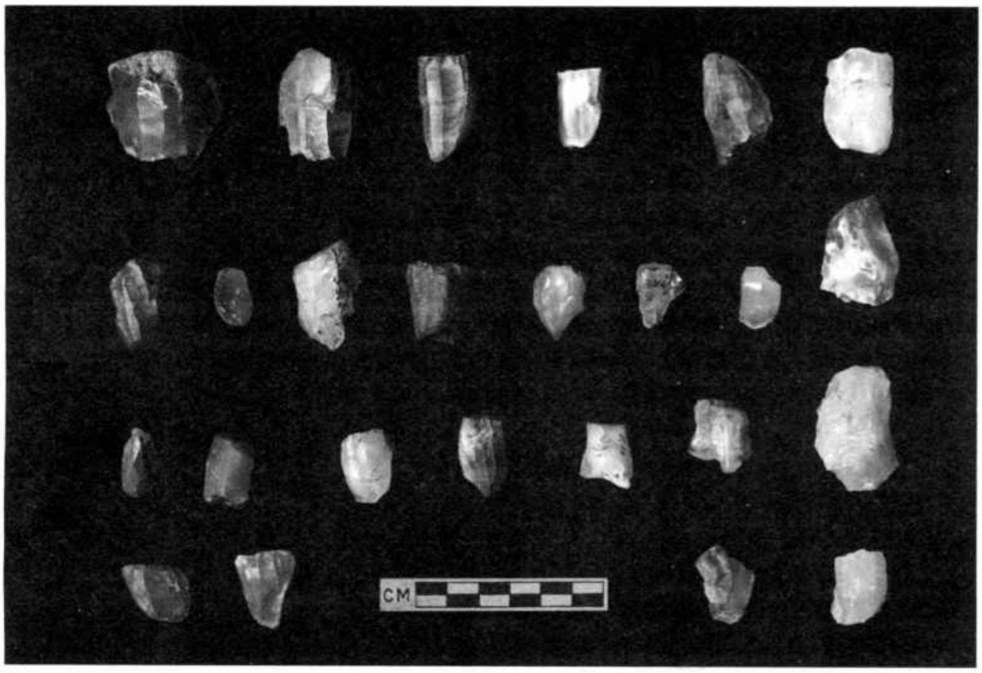

Fig. 4: Cores used for making microliths

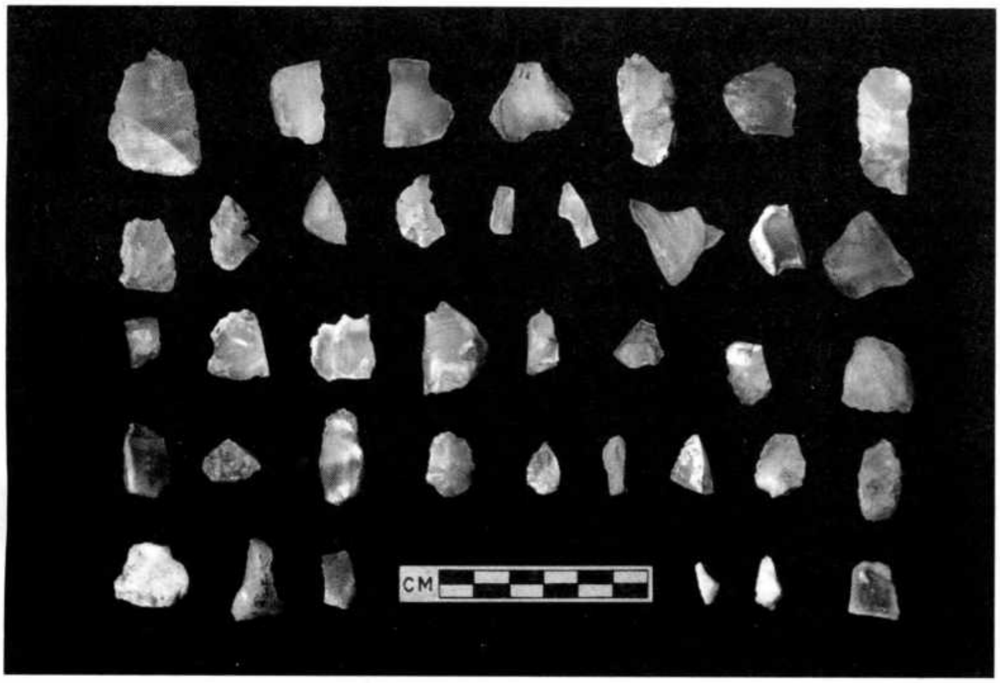

Fig. 5: Microliths

microliths cores and debitage found in association with these objects indicate a Mesolithic period factory site. It is likely that grinding stones and hammers were used over a long period of time perhaps for different purposes: used for food processing or for grinding and processing raw material. It is not unlikely that prospectors for gold also occupied the area at some point of time. It may be brought to notice that identical grinding equipment has been located by us near the ancient gold mining on the top of the nearby hills. In addition to this, it may be stated that hearth/furnaces along with tuyere could not have been used by the Mesolithic tool makers. Therefore, we presume that this site was inhabited time and again by different cultures and communities.

Note on "A Gazetteer of Pre- and Protohistoric Sites in Gujarat"

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In the article titled "A Gazetteer of Pre- and Protohistoric Sites in Gujarat", Volume XXXII, Number 2, 2007, pages 61-136, by Rajesh S.V. and Ambika Patel, had some errors in site names and references. These serious errors unintentionally occurred during final stage of editing by the first author and went unnoticed. The authors apologise for the same. Repeated reporting of the already reported sites stands as the major drawback of site related published data from the region of Gujarat. As this article is based on secondary data, there are all possibilities of mentioning secondary references. The corrections are listed below.

In first paragraph, first line and third paragraph, third line **2247 sites** should read **2246 sites**

Page no 61: in the Table, No. of sites in S. No. 3, **022** should read **021**

In References, **Mirchandani, R. M. 1981.** should read **Mirchandani, R. M. 1980.**

In References, **Patel, A. 1992.** should read **Ambikakumari, R. 1992.**

In the References section, following references are added.

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In whole article **Mahesana** should read **Mehsana Panchmahals** should read **Panchmahal Mirchandani 1981** should read **Mirchandani 1980**

Ghosh 1989 should read **c.f. Ghosh 1989**

Patel 1992 should read **c.f. Ambikakumari 1992**

Possehl 1999 should read **c.f. Possehl 1999**

Sonawane 2002 should read **c.f. Sonawane 2002**

Devi 2003 should read **c.f. Devi 2003**

Table 3, S. No. 21, in district **Ahmedabad** should read **Panchmahal**, latitude - should read **23° 14' 00" N**, longitude - should read **73° 43' 00" E** and addition in references are **Allchin and Goudie 1971**, **Allchin *et al.* 1978**.

Table 3, S. No. **22 and its details should be deleted**

Fig. 3, in number of sites in Ahmedabad **2** should read **1**

Table 5, in references of S. Nos. 162 (**Bhan 1997**), 340 (**Bhan 1984**), 372 (**Bhan 1995**), 410 (**Bhan 1986**), 411 (**Bhan 1988**), 412 (**Bhan 1987**), 424 (**Bhan 1990**) and 588 (**Bhan 1996**) should read **Bhan 1983**

Table 5, S. No. 8, in references should add **IAR 1980-81**

Table 5, S. No. 12, in references should add **Sankalia 1946, Sankalia 1965**

Table 5, S. No. 21, in references should add **IAR 1974-75**

Table 5, S. No. 26, in site name **Amranghna Muvada** should read **Amranjina Muvada** and in references should add **IAR 1977-78**

Table 5, S. No. 28, in site name **Anada** should read **Amroli**, district **Jamnagar** should read **Vadodara** and in references **Patel 1992** should read **Mehta 1957**

Table 5, S. No. 29, in site name **Anandpur** should read **Asoj**, distrcit **Ahmedabad** should read **Vadodara** and in references **Patel 1992** should read **Sankalia 1965**

Table 5, S. No. 31, in references should add **IAR 1968-69**

Table 5, S. No. 33, in site name **Anger** should read **Dokeriya**, district **Kachchh** should read **Vadodara** and in references **Patel 1992** should read **Sankalia 1946**

Table 5, the **repetition of S. Nos. 32 and 33 (before S. No. 34) should remove**

Table 5, S. No. 34, in references **IAR 1963-64** should read **IAR 1964-65**

Table 5, S. No. 35, in references should add **IAR 1977-78**

Table 5, S. No. 37, in references should add **IAR 1967-68**

Table 5, S. No. 38, in references should add **Bhan 1983**

Table 5, S. No. 40, in site name **Auguria** should read **Bajipura**, district **Banaskantha** should read **Surat** and in references **Patel 1992** should read **Mehta 1957**

Table 5, S. No. 44, in references should add **IAR 1977-78**

Table 5, S. No. 48, in site name **Bahiyal** should read **Bodeli**, district **Ahmedabad** should read **Vadodara**, and in references **Patel 1992** should read **Sankalia 1946**

Table 5, S. No. 52, in references should add **Bhan 1983**

Table 5, S. No. 56, in site name **Baleshi** should read **Balethi**

Table 5, S. No. 57, in site name **Baleshwar** should read **Valam**, district **Bharuch** should read **Mehsana** and in references **Patel 1992** should read **Sankalia 1965**

Table 5, S. No. 58, in site name **Baleth** should read **Malgad**, district **Surat** should read **Banaskantha** and in references **Patel 1992** should read **IAR 1993-94**

Table 5, S. No. 59, in references should add **Parikh 1977**

Table 5, S. No. 62, in references should add **Sankalia 1965**

Table 5, S. No. 63, in references should add **IAR 1977-78**

Table 5, S. No. 97, in site name **Bhutaria** should read **Bhutakia** and in references should add **IAR 1983-84**

Table 5, S. No. 98, in references **IAR 1970-71** should read **IAR 1971-72**

Table 5, S. No. 108, in references should add **IAR 1968-69**

Table 5, S. No. 112, in site name **Chak** should read **Chiklota**, district **Ahmedabad** should read **Bharuch** and in references **Patel 1992** should read **Mehta 1957**

Table 5, S. No. 128, in references should add **Parikh 1977**

Table 5, S. No. 136, in references should add **IAR 1977-78**

Table 5, S. No. 140, in references should add **Parikh 1977**

Table 5, S. No. 143, in site name **Dentali** should read **Dantali** and in references should add **IAR 1982-83**

Table 5, S. No. 158, in references should add **Bhan 1983**

Table 5, S. No. 160, in references should add **IAR 1977-78**

Table 5, S. No. 162, in site name **Dharmpur** should read **Khandoran**, district **Jamnagar** should read **Mehsana** and in references **Bhan 1997** should read **Sankalia 1965**

Table 5, S. No. 163, in references should add **Sankalia 1965**

Table 5, S. No. 178, in site name **Ervada** should read **Eravada** and in references should add **IAR 1982-83**

Table 5, S. No. 179, in references should add **IAR 1975-76**

Table 5, S. No. 188, in site name **Gamnia ni Timbi One** should read **Jojhwa**, district **Kachchh** should read **Vadodara** and in references **Patel 1992** should read **Mehta 1957**

Table 5, S. No. 192, in references should add **Mehta 1957**, **Sankalia 1965**

Table 5, S. No. 196, in site name **Ghadhara** should read **Ghadhara I** and in references should add **Sankalia 1946**

Table 5, S. No. 197, in district **Broach** should read **Bharuch**

Table 5, S. No. 207, in site name **Godadha** should read **Ghadhara II**, district **Surat** should read **Mehsana** and in references **Patel 1992** should read **Sankalia 1946**

Table 5, S. No. 212, in site name **Golau** should read **Goldha**, district **Surat** should read **Bharuch**, and in references **Patel 1992** should read **Mehta 1957**

Table 5, S. No. 215, in site name **Gota** should read **Gawar**, district **Ahmedabad** should read **Bharuch**, latitude **22° 07' 00" N** should read -, longitude **72° 32' 00"** E should read – and in references **Patel 1992** should read **Mehta 1957**

Table 5, S. No. 226, in site name **Haldravad** should read **Haldarvas** and in references should add **Momin 1979**

Table 5, S. No. 232, in references should add **IAR 1977-78**

Table 5, S. No. 234, in references should add **Bhan 1983**

Table 5, S. No. 242, site name **Hirpur** should read **Hirapur** and in references should add **Mirchandani 1980**

Table 5, S. No. 243, in references should add **Sankalia 1946**

Table 5, S. No. 264, in references should add **IAR 1977-78**

Table 5, S. No. 274, in references should add **Parikh 1977**

Table 5, S. No. 275, in site name **Juna Ishnaria** should read **Jhandada no Thumda Two**, district **Bhavnagar** should read **Banaskantha** and in references **Patel 1992** should read **IAR 1992-93**

Table 5, S. No. 276, in references should add **IAR 1977-78**

Table 5, S. No. 278, in references should add **Sankalia 1965**

Table 5, S. No. 281, in references should add **IAR 1977-78**

Table 5, S. No. 284, in site name **Kadod** should read **Karoli**, district **Surat** should read **Mehsana** and in references **Patel 1992** should read **Sankalia 1965**

Table 5, S. No. 290, in references should add **IAR 1990-91**

Table 5, S. No. 300, in site name **Karachchala** should read **Karachla**

Table 5, S. No. 307, in site name **Kava Dam** should read **Kandava Dam**

Table 5, S. No. 309, in site name **Kelamal** should read **Kelamul**

Table 5, S. No. 327, in site name **Khidhalia Timbo** should read **Khidhadia Timbo** and in references should add **IAR 1990-91**

Table 5, S. No. 330, in site name **Khothawadi Timbo (Bhojavadar)** should read **Kola – Kotardi**, district **Bhavnagar** should read **Vadodara**, latitude **21° 52' 00" N** should read -, longitude **71° 42' 00" E** should read – and in references **Jairath 1986** should read **Mehta 1957**

Table 5, S. No. 336, in site name **Kotai** should read **Kola**, latitude **22° 10' 00" N** should read -, longitude **69° 42' 00"** E should read – and in references **Patel 1992** should read **IAR 1980-81**

Table 5, S. No. 341, in references should add **IAR 1971-72**

Table 5, S. No. 342, in references should add **Mehta and Sonawane 1970**

Table 5, S. No. 343, in references should add **IAR 1971-72**

Table 5, S. No. 344, in references should add **IAR 1977-78**

Table 5, S. No. 347, in site name **Kuradai** should read **Kanja** and in references **Patel 1992** should read **Sankalia 1965**

Table 5, S. No. 358, in district should add **Vadodara**

Table 5, S. No. 360, in latitude **23° 80' 00" N** should read **23° 27' 00" N**, longitude **72° 50' 00" E** should read **72° 32' 00" E** and in references should add **Sankalia 1946**

Table 5, S. No. 378, in site name **Mahakaleshwar** should read **Mahakaleshwar Dungar** and in district **Dungar** should read **Vadodara**

Table 5, S. No. 388, in site name **Maliapur** should read **Maliapura** and in references **Patel 1992** should read **Sankalia 1965**

Table 5, S. No. 399, in site name **Medakui** should read **Merakui**

Table 5, S. No. 406, in references should add **Sankalia 1965**

Table 5, S. No. 407, in references should add **Mehta 1965, Allchin and Goudie 1971, Allchin *et al.* 1978**

Table 5, S. No. 418, in site name **Morgana** should read **Morangana**

Table 5, S. No. 431, in site name **Mulson** should read **Mulsan** and in references **Patel 1992** should read **Sankalia 1965**

Table 5, S. No. 433, in site name **Muvada** should read **Manekli**, district **Ahmedabad** should read **Vadodara** and in references **Patel 1992** should read **Mehta 1957**

Table 5, S. No. 444, in references should add **IAR 1977-78**

Table 5, S. No. 461, in site name **Nikna** should read **Nikawa I** and in references **Patel 1992** should read **Bhan 1983**

Table 5, S. No. 471, in district **Sabar Kantha** should read **Sabarkantha**

Table 5, S. No. 477, in references should add **IAR 1990-91**

Table 5, S. No. 479, in district should add **Vadodara**

Table 5, S. No. 481, in references should add **Momin 1979**

Table 5, S. No. 482, in references should add **IAR 1982-83**

Table 5, S. No. 484, in site name **Paro-no Timbo (Juna Ishvariya)** should read **Pandaro-no Timbo**

Table 5, S. No. 485, in site name **Pasanj** should read **Mandavi**, district **Ahmedabad** should read **Bharuch** and in references **Patel 1992** should read **Mehta 1957**

Table 5, S. No. 486, in references should add **Jairath 1986**

Table 5, S. No. 496, in references should add **Sankalia 1946, 1965**

Table 5, S. No. 499, in site name **Phathodra** should read **Pathodra** and in references should add **IAR 1974-75**

Table 5, S. No. 508, in site name **Prahladgadh** should read **Mandir wala Thumda (Ujjanwada)**, district **Bhavnagar** should read **Banaskantha** and in references **Patel 1992** should read **IAR 1992-93**

Table 5, S. No. 517, in references should add **Jairath 1986**

Table 5, S. No. 518, in references should add **Jairath 1986**

Table 5, S. No. 522, in references should add **IAR 1980-81**

Table 5, S. No. 529, in site name **Rampur** should read **Rampura** and in references should add **Sankalia 1946, 1965**

Table 5, S. No. 533, in site name **Randevi** should read **Kevadia**, district **Bharuch** should read **Kheda** and in references **Patel 1992** should read **IAR 1967-68**

Table 5, S. No. 540, in site name **Rapamora** should read **Rupamora** and in references should add **Bhan 1983**

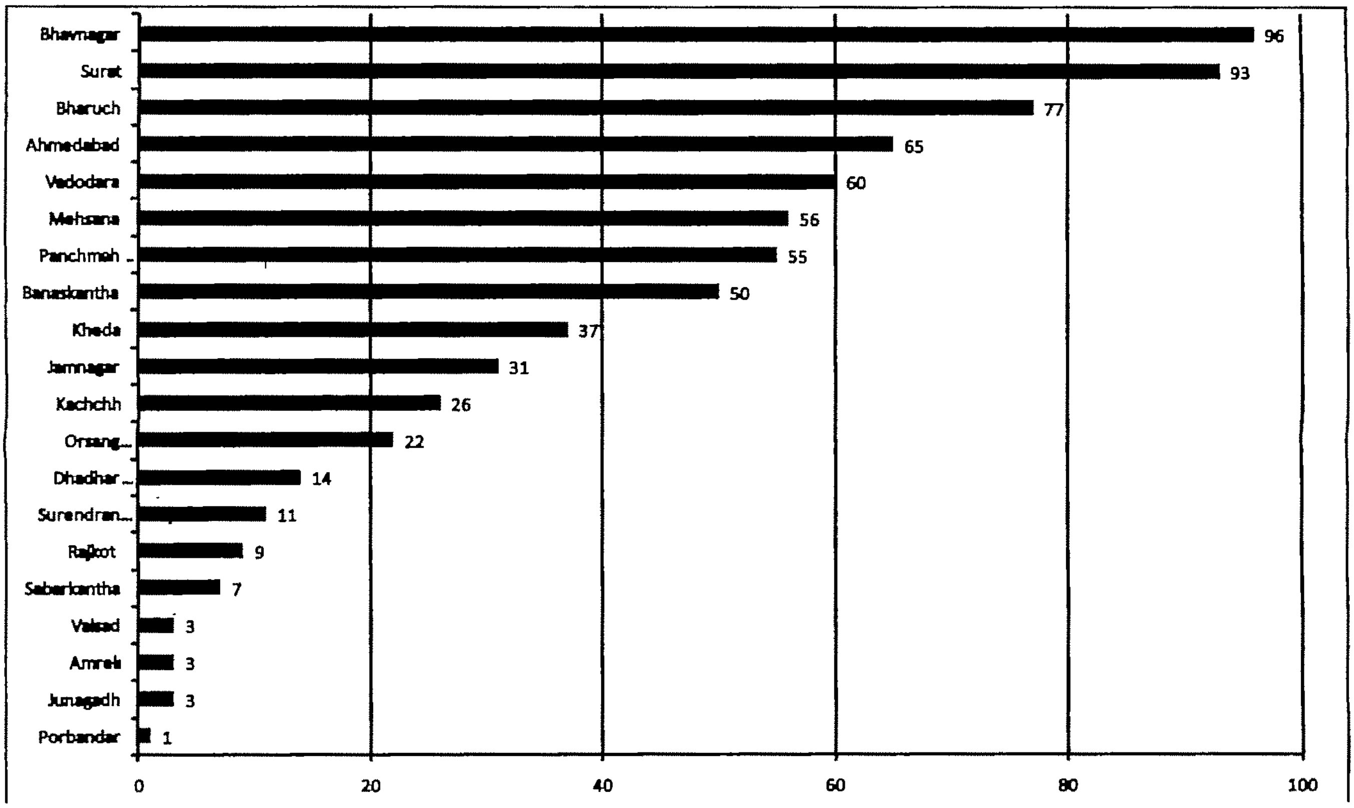

Table 5, S. No. 542, in site name **Ratan Tekra** should read **Jhandada no Thumda II** and in references **Patel 1992** should read **IAR 1992-93**

Table 5, S. No. 543, in references **IAR 1963-64** should read **IAR 1964-65**

Table 5, S. No. 545, in site name **Raval One** should read **Serula**, district **Mehsana** should read **Surat**, latitude **23° 38' 00" N** should read -, longitude **71° 51' 00" E** should read - and in **references Patel 1992** should read **Sankalia 1965**

Table 5, S. No. 546, in site name **Raval Three** should read **Rengan**, district **Mehsana** should read **Vadodara**, latitude **23° 38' 40" N** should read -, longitude **71° 51' 50" E** should read - and in references **Patel 1992** should read **Mehta 1957**

Table 5, S. No. 547, in site name **Raval Two** should read **Ramgadh I**, district **Mehsana** should read **Vadodara**, latitude **23° 38' 00" N** should read -, longitude **71° 51' 50" E** should read - and in references **Patel 1992** should read **Mehta 1957**

Table 5, S. No. 552, in district should add **Vadodara**

Table 5, S. No. 559, in site name **Runi** should read **Sulpan**, district **Mehsana** should read **Bharuch**, latitude **23° 28' 00" N** should read -, longitude **71° 58' 00" E** should read – and in references **Patel 1992** should read **Mehta 1957**

Table 5, S. No. 564, in site name **Sajroli-Mo** should read **Sanjroli Moti**

Table 5, S. No. 571, in references should add **Mirchandani 1980**

Table 5, S. No. 575, in references should add **IAR 1980-81**

Table 5, S. No. 576, in references should add **Parikh 1977**

Table 5, S. No. 584, in references should add **IAR 1980-81**

Table 5, S. No. 587, in site name **Sarota** should read **Sarotra** and in references should add **Parikh 1977**

Table 5, S. No. 593, in site name **Shedravadar** should read **Shedhavadar**

Table 5, S. No. 596, in site name **Shetpur** should read **Sherpura**

Table 5, S. No. 598, in site name **Shiyal/Magvana Timbo** should read **Shiyal/Magavana no Timbo** and in references should add **IAR 1976-77**

Table 5, S. No. 605, in references should add **IAR 1974-75**

Table 5, S. No. 607, in site name **Surajwada** should read **Surajwad**

Table 5, S. No. 616, in site name **Taldara** should read **Tajpur**, district **Bharuch** should read **Surat** and in references **Patel 1992** should read **Mehta 1957**

Table 5, S. No. 620, in site name **Tanchasar** should read **Panchasar** and in references should add **IAR 1982-83**

Table 5, S. No. 622, in references should add **Bhan 1983**

Table 5, S. No. 629, in site name **Thaltej** should read **Sigam Kanbi**, district **Ahmedabad** should read **Vadodara** and in references **Patel 1992** should read **Sankalia 1946**

Table 5, S. No. 632, in site name **Thaverpur** should read **Turkhera** and in references **Patel 1992** should read **IAR 1993-94**

Table 5, S. No. 644, in references should add **IAR 1980-81**

Table 5, S. No. 649, in references **IAR 1970-71** should read **IAR 1971-72**

Table 5, S. No. 657, in site name **Vadad** should read **Vasad** and in references **Patel 1992** should read **Sankalia 1946**

Table 5, S. No. 659, in site name **Vadakhavantha** should read **Waru**, district **Bharuch** should read **Ahmedabad** and in references **Patel 1992** should read **Sankalia 1946, 1965**

Table 5, S. No. 663, in site name **Vad-Ghrudeshwar** should read **Vad-Garudeshwar**

Table 5, S. No. 666, in site name **Vadia** should read **Vadia II**, district **Bharuch** should read **Vadodara**

Table 5, S. No. 667, in references should add **Mehta 1957**

Table 5, S. No. 668, in references should add **Parikh 1977**

Table 5, S. No. 669, in latitude **22o 19' 00" N** should read **22° 19' 00" N** and in longitude **71o 52' 00" E** should read **71° 52' 00" E**

Table 5, S. No. 677, in references should add **Sankalia 1946, 1965**

Table 5, S. No. 685, in site name **Vanch** should read **Tajpura**, district **Ahmedabad** should read **Panchmahal** and in references **Patel 1992** should read **IAR 1998-99**

Table 5, S. No. 692, in site name **Vashi** should read **Verai Mata no Timbo**, district **Ahmedabad** should read **Mehsana**, latitude **22° 50' 50" N** should read **23° 27' 00" N**, longitude **72° 32' 50" E** should read **72° 29' 00" E** and in references **Patel 1992** should read **Sankalia 1946**

Table 5, S. No. 693, in site name **Vasmed** should read **Nasmed** and in references **Patel 1992** should read **IAR 1982-83**

Table 5, S. No. 697, in site name **Vatroli** should read **Valotri** and in references **Patel 1992** should read **Momin 1979**

Table 5, S. No. 708, in references should add **Mehta 1957**

Table 9, S. No. 46, in site name **Moti Pipli** should read **Moti Pipli (Shakatri Timbo)** and **(Shakatri Timbo)** should remove from references

Table 10, S. No. 4, in site name **Akhavadi no Timbo** should read **Akhavadi no Timbo (Goradka)** and **(Goradka)** should remove from references

Table 10, S. No. 31, in references **Bhan 198** should read **Bhan 1989**

Table 11, S. No. 283, in references **Ghosh 1989/** should read **c.f. Ghosh 1989**

Book Reviews

Archaeology and Text: The Temple in South Asia

Himanshu Prabha Ray (Ed.)
New Delhi, Oxford Univ. Press, 2010.

The volume under review contains thirteen papers selected from those presented at the seminar organized by the Oxford Centre for Hindu Studies in 2005. They are divided into two groups, eight in the section of 'Archaeology of the Temple', and the remaining five dealing with 'Asceticism and Bhakti'. The first paper 'Creating Religious Identity: Archaeology of Early Temples in the Malaprabha Valley', is a longish essay on the Chalukyan temples in the Badami – Aihole region. The author gives an account of the important temples and concludes that the region was sacred even in prehistoric times as the locations of megalithic monuments would indicate. This reminds us of the late Professor D.D. Kosambi's observation that, megalithic monuments, more particularly dolmens near Pune, were folk shrines and as such were sacred spots.

Dr. Ray has referred to what are commonly known as 'Lajja-gauri figurines which are nude female torsos, with outstretched legs. Badami is known for the shrine of this divinity which, however is described as 'Shakambhari' in the local *mahatmya*. It is woshipped at present by barren women for procuring an offspring, which clearly indicates her association with fertility. Interestingly, the Warlis of Thana District near Mumbai worship such a headless deity on the occasion of a wedding in the family. The goddess is associated with childbirth as a third century inscription from Nagarjunkonda describes it. As a matter of fact the antiquity of such headless, nude figures can be traced back to prehistoric times, the earliest being her representation in an Upper Palaeolithic painting in France.

Dr. Parul Pandya Dhar has traced the early history of the Ambika temple at Jagat (Rajasthan) in which the image of the deity is of a later date than that of the temple. She focuses on the textual evidence in respect of worship in a shrine where the image of the presiding deity is stolen or missing, and how the worship can be revived in such cases. Textual evidence has also been cited by Devangana Desai and Kumud Kanitkar, the former for the Khajuraho temples and the latter for Ambarnath temple. They have both identified some of sculptured panels adorning the walls of the temples as depicting certain rituals prescribed in *Vastu* texts which is convincing. The sculptural representation of the *Sutradhara* in the Ambarnath temple is indeed unique in as much it underlines his key role in the construction of the temple.

Chota Kailas (Cave 30) at Ellora has been compared with the great Kailas (cave16) at the same site by Lisa N. Owen. The former is an almost copy of the latter, one third of its size, but both belong to different faiths, the former to Jain and the latter is Hindu. Curiously enough chota Kailas is unfinished, only its upper half is finished. It is later by a couple of centuries (10th century) than its prototype. Lisa Owen has raised a question: why some of the visual forms of Kailas (cave16) were appropriated by the Jains? These occur only in the upper finished half of the structure and the only answer seems to be that it was in all probability started as a Hindu shrine and was later taken over by the Jains. The work had to be given up after some time as it was realized by the Jain patron that it will not fulfill the needs of his creed. They had already converted a Buddhist cave (main cave at Dharasiv) into a Jaina shrine but could not do it at Ellora.

Another interesting paper is Sanjay Goyal's 'Money of the Gods' which draws attention to a neglected aspect of numismatics. The *tankas* were first minted by the Hoysalas, followed by their feudatories, the Yadavas. The latter issued the gold coins, the Padma-tankas bearing Ram-Sita figures. The author asks why such tokens are not found in north India. According to one authority it was probably due to the rule of iconoclasts. But this view is not tenable as Jahangir had issued Ram-Sita medals which were used for the same purpose.

There are five papers grouped under 'Bhakti' among which that by Patrick Olivelle examines the term temple from the legal point of view. He found no reference to temple in early Dharmashastra texts, as for instance in Apastamba (3rd century B.C.); it occurs for the first time – *devayatana* – in Gautama which may be the shrine room in a house. This is in a way supported by the evidence of early temples such as the Vishnu shrine at Vidisha, referred to as Narayana Vatika (2nd century B.C) and *puja-sila-prakara* at Ghosundi (1st century B.C.). Kautilya gives locations of temples in a city. The absence of temple as a public place in the earlier period shows the individualistic nature of Hinduism in which each one has his god or goddess in a small niche in the house. The author further discusses temple as a social institution. Natali R. Lidowa shows how *yajna* and *puja* are two different terms although both occur in Vedic literature. The Bhakti movement according to John Stratton Hawley started from the *Bhagavata Purana*, particularly in South India, with the Alvars. John E. Cort deals with Jaina asceticism whereas T.S. Rukmani examines the relationship between a renouncer and the temples in Jainism.

The volume, being an Oxford University Press publication, is elegantly produced and is a significant addition to Indian religious history.

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Kothrud, Pune

The Palaeolithic Settlement of Asia

R.W Dennell

2009. Cambridge: Cambridge University Press.

Dennell's book 'The Palaeolithic Settlement of Asia' has been available for a year now. It is difficult to review this book because although it is excellent in some ways, I find myself in profound disagreement with almost all the authors' major interpretations.

The first two chapters of the book are introductory, "Asia and its Place in Palaeoanthropology "and "The African Background to the Colonization of Asia". The "African Background" is a well written summary of the important sites and work in Africa and will be very useful for students as an entry into the literature. Dennell has divided the book into two time horizons, the period before 1 million years and the period from 1 million years to the last interglacial. The time period later than the last interglacial is not discussed. The climatic background is discussed in two separate chapters, chapter 3 for the earlier period and chapter 7 for the later one. In the earlier time period Asia is divided into South Asia (chapter 4) and the rest of Asia (South and Southeast Asia and China, chapter 5). The later time period is divided into three regions, Southwest and Central Asia (chapter 8), India (chapter 9) and Southeast Asia and China (chapter 10). Chapters 6 and 11 discuss evidence under the headings "Out of Africa 1 reconsidered and the earliest colonisation of Asia" and "Human evolution in Asia during the Middle Pleistocene", respectively. The final chapter (11) comprises concluding remarks.

Dennell considers environmental factors to be important in human evolution, which they are. The two chapters on palaeoclimate however are not well integrated into the narrative. In too many cases the climate records are merely described. The major features of Quaternary climate are similar in all the long climate records whether from ocean cores, lake sediments, loess or ice, so that discussion of the ones specifically from the Asian region entails a lot of repetition. The discussion of Quaternary palaeoclimate has been done much better by others, and Dennell could have spent the pages more profitably in focusing only on the relationship between environment and human dispersals and adaptations. These chapters drag and are likely to be skipped by the reader. These chapters are too simple for the person seriously interested in palaeoclimate but still too complex for the novice. It would have been good to evaluate the palaeoclimatic evidence from the archaeological sites themselves, considered faunal changes in more detail, evaluate ecological barriers to human dispersal versus geographic barriers and bring out the differences between the different time periods in a more detailed way.

In chapters 6 and 11, in which the evidence from the two time periods are discussed Dennell does not to give his own viewpoint directly. Chapter 6 discusses how the recent early dating of hominin fossils at Dmanisi and stone tools in the Nihewan basin throws the whole question of the dating of the earliest dispersal from Africa into doubt. He discusses alternative dates for the first appearance of Homo outside of Africa but just enumerates different ideas published by other people and the reader is not given Dennell's own viewpoint on this issue. Dennell does have his own theory which has appeared as an extended abstract of his paper read at the international colloquium on "The oldest human expansions in Eurasia from Africa: favouring and limiting factors" in November 2008 at Paris, just as the book was being published (Dennell et al. in press). Dennell must have reasons for not discussing his own theory but it is difficult to understand what they might be. These ideas do lurk behind his selection of sites discussed and even the organization of the book and it is irritating to read it elsewhere and then realize "So that's why!" for something you were puzzled with in the book. Thus the large role he gives to southwestern Asia in the book becomes understandable when you find out that "The proposed central area of dispersals is located in Western Eurasia". The chapter on the later period is dominated by a discussion of the fossil hominins and very little discussion is devoted to the archaeological evidence. He emphasizes the diversity of hominins in this time period compared to the earlier one. Once more the absence of Dennell's own conclusions and viewpoint adds to the confusion. Dennell followed the same strategy in his Pabbi Hills book (Dennell 2004), where he presents only data in the book. His papers written at the same time as the book, give the conclusions derived from that study (2003, 2004, 2005). While this can be justified in the Pabbi Hills case where he is reporting his own work, this makes less sense in this book "Palaeolithic Settlement of Asia" which is a work of synthesis and interpretation rather than reporting.

The core of the book therefore is the chapters discussing the primary data-the archaeological evidence itself. Dennell follows the approach of focusing on key sites. His summaries of the sites of Dmanisi and, 'Ubeidya in chapter 4, Dennell's own work at Riwat and Pabbi hills, the Javan sites, the Nihewan basin sites in Northern China, Lantien, Longgupo and Yuanmou in chapter 5, Gesher Benot Ya'aqov, Bizat Ruhama, Holan, Revadim, Berekhat Ram, Umm Qatafa, Tabun, Jabrud, Zuttiyeh, El-Khowm, Adlun, Qesem, Karain E, the Tajik, "loess Palaeolithic" and Sel'ungur in chapter 8 are good summaries of the information from these sites which are published in scattered sources. Chapter 9, which is on India, selects Chirki, the Son and Belan valleys, the Didwana sites, Bhimbetka, the Hunsgi Baichbal valleys, the Kalagdi basin and the Kortallaiyar Basin for discussion.

While I found Dennell's discussion of sites in the other chapters good, I was quite disappointed with his discussion of the Indian material. There are a many errors. Dennell, in discussing the site of Chirki reports the Th/U date as coming from "layer 3" at Chirki, citing Petraglia (1998). However, the horizon dated, is not from Chirki, but from Laxmi nala which is the area studied not by Corvinus (1983) but by Sankalia (1956). At Nevasa there are a number of Acheulian localities, of which the Chirki locality was discovered and studied by Corvinus, while Sankalia's main locality was "Locality 1" which Corvinus refers to as "Laxmi nala" Both Sankalia (1956) and Corvinus (1983) obtained Acheulian artefacts from the Laxmi nala locality. The calcrete dated at Laxmi nala is a calcrete layer at the contact between the Acheulian sediments and basalt bedrock and so pre-dates all the artefacts there. Dennell also refers to "Nevasa River" which is wrong, as the river is the Pravara and Nevasa is the town. He also suggests that Chirki is located on a "spring" citing "personal communication" from Petraglia. This is again a misleading statement. The recent finding of reversed palaeomagnetism from the Laxmi nala section (Sangode 2007) is also missing from his discussion.

In the discussion of Son and Belan rivers Dennell suggests that they are located in "Madhya Pradesh and Andra Pradesh" which is wrong. Belan is a tributary to the Son and both are in Madhya Pradesh. Andhra Pradesh, not Andra Pradesh, is in quite a different part of India. Dennell also only refers to the work in this area from the 1980's and does not refer to Williams *et al.* 2006 or Pal *et al.* 2005 in which a number of revisions to the stratigraphy have been made. Williams *et al.* 2006 now place the tephra horizon in a new formation, the Khunteli formation, and the oldest of all the formations in the Son valley. In the discussion of the Didwana sites, I was quite puzzled as to his mention of the site "Bandlav-ki-Talav" which is nowhere mentioned in any of the publications related to the area, while the sites of Jankipura, Indoli-ki-dani and Mangalpura from which some data are published are not mentioned. In the section on Bhimbetka, Dennell states that the site overlooks the Narmada River but although the Bhimbetka hill range is the divide between the Narmada and Betwa, the caves studied are on the northern slopes and overlook the Betwa River, not the Narmada. Perhaps these errors are minor and unimportant, but they still show a lack of familiarity with the material and lead me to wonder what errors are present in the chapters on other regions where my familiarity with the data is less.

Dennell divides the Indian sites into studies of individual sites and "settlement pattern" studies in which he discusses the Raisan area, Paisra, the Hunsgi Baichbal valleys, Kaladgi Basin and the Kortallaiyar Basin. Although archaeologists may use terms like settlement pattern, this is misleading in a Lower Palaeolithic context. These studies are more properly considered as "regional" studies, where the archaeological material from a region has been studied rather than an individual site, and it is the norm rather than exception in Indian Prehistoric studies. If you consider the long time period of the Lower Palaeolithic, then even the most dense and well explored regions have few sites. Dennell therefore makes some rough calculations in relation to the Hunsgi Baichbal valley and concludes that the Palaeolithic populations were low, and occupation was discontinuous. He does not consider formation processes at all. Dennell's assumption that "little archaeological material appears to have been lost" is hardly justified. It may not have been lost through stream action, but weathering processes are extremely destructive over long time periods (Mishra 1982). Dennell suggests that only a few "core areas" might have had continuous occupation and suggests these might be the "Purana basins" as suggested by Korisettar (2007). As Mishra (2007) has pointed out the greater abundance of Acheulian sites in the Purana basins is merely due to the presence of quartzite in these basins, so that more tools were made on quartzite which is more resistant to weathering and thus survives longer. The surviving sites are certainly a small proportion of the sites that ever existed and Dennell's interpretation of the "settlement patterns" seems bizarre.

My main disagreement with Dennell in the interpretation of the Indian evidence is his consideration that the Indian Acheulian is similar in age to the European Acheulian. This is based on the following reasoning– "Because faunal exchange between Levant and Sub-Saharan Africa ceased in the Middle Pleistocene, and was minimal with North Africa, the Acheulian of Europe and India is almost certain to have originated in the Levant where bifaces were first used 1.4 ma at 'Ubeidya and at subsequent sites such as Latamne and GBY" (pp.392) This consideration, however, just means that the Acheulian in India could not have spread from Africa in the Middle Pleistocene, and it does not rule out the possibility that the Acheulian reached India from Africa before the Middle Pleistocene. Considering the similarity of the Indian Acheulian to that of Africa, rather than Europe, the lack of Middle Pleistocene faunal exchange is rather an argument for an older age of the Indian Acheulian than for its derivation from the Levant. It seems strange that Dennell never seems to have considered this alternative interpretation.

Surprisingly Dennell considers that "the Middle Pleistocene archaeological record of India mirrors that of Europe in several respects: scale, timing, origin, and nature of settlement"(pp. 395). By considering formation processes insignificant, he infers shallow time depth and discontinuities in the archaeological record. In reality, however the Indian Palaeolithic is remarkably homogeneous and continuous (Mishra 2008). Dennell expects that any Lower Pleistocene Palaeolithic industry in India would be non Acheulian "mode 1" as it is in Europe, and so infers that since there is no "mode 1" there are no Lower Pleistocene industries. Since the Acheulian is found in Africa at 1.6 myr and only shortly later in the Middle East, this reasoning is again, strange. Java is considered along with SE Asia and China rather than India but during the Lower and Middle Pleistocene, it was ecologically more similar to India. The fauna associated with hominins in Java is closely related to the Pinjor fauna from India. Faunal exchange between India and Java therefore did occur and Dennell's statement that "An inescapable aspect of South Asian geography is that India is difficult both to enter and to exit" (pp. 393) seems to be overstated.

Dennell has made a sincere effort in this book, but I cannot help being disappointed at his surprising interpretations of the Indian Palaeolithic.

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Excavations at Sisupalgarh, Orissa

R.K. Mohanty and Monica L. Smith

2008. Indian Archaeological Society, New Delhi, pp. 72. Price Rs. 800/-

Sisupalgarh, now a part of growing city of Bhubaneswar in Orissa, is known for a massive fortification, a moat and monumental architecture. The site was excavated half a century ago then in the Archaeological Survey of India udder supervision of Prof. B.B. Lal. The site measures about 1 x 1 km and is under threat of recent urban encroachment. R.K. Mohanty (Deccan College, Pune) and Monica L. Smith (University of California, Los Angeles) began investigations at the site in 2002. This book is an outcome of systematic site surveys and meticulously conducted excavations from 2005 till 2008.

The book has a foreword by the first excavator, Prof. B.B. Lal. He states the importance of geophysical surveys carried out by Mohanty and Smith. Indeed, conducting a survey using non-destructive techniques such electrical resistivity and magnetic gradiometry as is a major welcome achievement of the project. A chapter in the book is devoted to the discussion of these geophysical survey methods and their findings. With the help of magnetic gradiometry it was possible to locate roads and sub-surface town planning features.

Several trenches were dug to understand the nature of habitation within the walled city. For this purpose the investigations (called Operations) were focused at and around the structures visible on the surface. The results of these operations are discussed in a separate chapter. In order to gain knowledge of the chronology, deep sounding operations were carried out at several places - on the western portion of the site (2005) and on the northern side of the site (2006). In the chapter titled "Excavations of Deep Soundings" the authors have discussed the rationale of using the deep sounding and the difficulties that they faced. At Sisupalgarh, the water table is higher inside of the rampart than outside. In 2005 the excavators encountered water at 2.1 m below surface. Similarly, in the 2006 deep sounding operation water started seeping at the depth of 2.6 m. The excavators had to pump the water and then only it was possible to continue. It was found that the natural soil was present at 5.6 to 6.7 m below present-day surface.

Research activities in 2008 were focused on two areas - the rampart that surrounds the urban core of the site and the central mound where pillars are visible above ground. Excavations conducted in the `pillar area' exposed previously unknown 18 monolithic pillars made of laterite. The excavators suggest that these pillars formed a large apsidal structure. They observed that to the domestic structures varied in their orientation, layout, size, and construction materials. On the basis of excavations, it is concluded that though the rampart and the pillar area constitute spectacular architectural features at Sisupalgarh, these differ in their construction technique and chronology (p. 53). It is also interesting that there were many successive layers of rampart augmentation. Excavations in 2007 revealed baked-brick architecture at the apex of the rampart was present. But in 2008 it was found that the rest of the rampart fill mostly consisted of simple earthen filling with very few fragments of bricks. The rampart came up during the early phase of occupation and continued to be maintained and augmented from time to time, whereas the pillar area belongs to the last major phase of occupation and was not augmented.

The excavations in the habitation areas enable us to visualize actions of various site formation processes. In the habitation areas, architecture varied according to the skill and requirement of the householder and the foundations in many cases were made of recycled materials, such as broken bricks, or fragmented laterite blocks.

The authors in their conclusions state that a series of comprehensive radiocarbon dates is awaited. However, on the basis of their preliminary observations they suggest a "robust" 1000 year span of occupation. As it looks from the brief conclusions given at the end, it is not a compete but a kind of interim report. The discussion onabout analysis of biological remains is missing. Perhaps the excavators are waiting for the specialists to submit their reports.

This book, though small in size is a valuable addition to our understanding of this important early historic urban centre in eastern India.

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Maritime Archaeology for Beginners

Sila Tripati

2009. New Delhi: Kaveri Books. Page 156, figures 40. Price: Rs. 495/-

These days, persons who master a subject write research papers rather than text books for common people. Eventually the standard of text books has been deteriorating. In this context the book under review by a well established maritime archaeologist, Dr. Sila Tripati is a path breaking study.

The book contains ten chapters, in which A-Z of maritime archaeology is explained. Indeed the book can be called as a dictionary of maritime archaeology.

Chapter I gives a brief history of maritime archaeology and explains this with suitable examples. Maritime archaeological studies in India commenced as late as in 1981 at the National Institute of Oceanography, Goa. The chapter discusses this work and subsequent research in this field. The scope of maritime archaeology is dealt with. Organisations where one can get training in maritime archaeology and future prospects of the subject are given; including the URL of websites, journals and books dealing with the subject. The history of maritime archaeology throughout the world is also discussed.

Chapter II gives a history of the development of maritime archaeology in India and discusses the contribution India has made in this field. It deals with the archaeology of port sites from the Harappan times onwards. The chapter lists common features of a port site. The history of ships and the material used for ship building are also dealt with.

Chapter III deals with different sources of evidence:-literature, travellers accounts, inscriptions and coins, archaeological artefacts, archival records and ethnographic information which all are useful for studying maritime archaeology. The author examines sources which are used to study maritime archaeology in India. In brief, he states the objectives of maritime archaeology.

Chapter IV introduces diving, types of diving, equipment required, and gives tips on what to do and what not to do before, during and after diving. Maritime archaeology is a specialized branch of archaeology, needing its own specific tools; and chapter V introduces these aspects of the discipline. Chapter VI describes exploration and search techniques of maritime archaeology, including different search patterns, photography, drawing and other issues. Chapter VII deals with surveys and excavations, and includes details of how to establish grids and how to recover antiquities.

Chapter VIII deals with shipwrecks. The material remains of wrecked ships are of great importance for archaeology. The chapter examines literary evidence, causes for shipwrecks post-wreck history. It also deals with the history of study of the shipwrecks in India in general and by NIO in particular.

Chapter IX gives details of post fieldwork processes. This chapter deals with different methods of conservation of antiquities and dating procedures. In the last chapter the international status of this subject is discussed. It also discusses academic organisations related to maritime archaeology, their role and activities.

The suggested reading list is useful for both beginners and scholars in this field, in particular as most of this material is not available in libraries in India. The select bibliography is exhaustive. An appendix lists all maritime sites explored and excavated in India. The other appendix gives 100 facts on maritime archaeology and other related issues.

Though the selection of photographs and line drawing is good, the maps could have been bigger. A chapter on reconstruction of Indian archaeology through maritime studies would have been worthwhile.

The book is a model text book and a must for all libraries and researchers dealing with maritime archaeology.

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Hunter-Gatherers in North and Central India: An Ethnoarchaeological Study

Malti Nagar

2008. Oxford: BAR International Series 1749, 105 pp, illustrations by the author.

Malti Nagar's book covers the prehistory of hunter-gatherers in northern South Asia, and then, going by macro-region (Ganga plains, Rajasthan, Central India), describes the ways of life of several hunter-gatherer groups of the twentieth century. She gives special importance to the Kanjars of Uttar Pradesh. A final chapter brings out the importance of this data for understanding prehistoric lifeways, accessible through the archaeological record. Like her teacher, H.D. Sankalia, she writes in a non-fussy style, avoiding hyperbole and gets straight to the point. The book is thus eminently readable (except that it has been so badly bound that it is falling apart in my hands), even if some may find that the starting account of the development from hunting-foraging to animal and plant domestication, sedentism, population growth, the advent of specialized crafts, urbanization, and the adoption of iron technology (pp. 3-5) is unnecessarily simplistic. The point the author makes, however, is that in tandem with this development process, hunting and a mobile life continued to exist, actually to evolve.

In various parts of the discourse, an explanation is offered for the persistence of hunting and gathering as a subsistence form. At the outset it is suggested that either the people concerned did not make the effort to become agriculturists or herders, or else were "too conservative" to change (elsewhere the point is made that they valued their freedom). The most important observation regarding this is (p. 6) that hunter-gatherer work rhythms are fluid and flexible, not taxing the people concerned. What I would query, however, is the author's conviction that today's hunter-gatherer cultures are relicts of the Mesolithic era. Is it not possible that recently and anciently, here and there, small groups of people lost their rights to their lands and were ousted into non-arable zones where their only option was to eke out a subsistence from their immediate environs? The reasons for this could have been the extension of state frontiers, the march of armies and the depredations of repeated warfare, excessive revenue demands, or annexation of their territory. The author certainly takes into account clashes with agriculturists, and the need for hunter-gatherers to take up craft production as a part of their livelihood, so that we should beware of looking at their lifeways as "pristine" or of the stone age .

So it is hard to imagine why stone age people on the vast and fertile Ganga plain could not take to agricultural production. The Kanjar of the Ganga plain, tall, slim and sharp-nosed (p. 31)—now reduced to fragments labelled "Kangiwalas" or "Lohiyas" (p. 32)—are, according to the author, "almost certainly descended from the pioneering Mesoplithic colonizers of these plains" whose skeletal remains reveal similar features (p. 39)—this reader is not convinced. Such equations only reinforce prejudice of the sort that relegates marginalized groups to a past without a history.

In each of the sections dealing with the macro-regions, Nagar refers to the ethnographies of the colonial period. The first account of hunter-gatherers on the Ganga plain, for instance, dates to 1818. Crooke's *Tribes and Castes* was an end-of-the-century compilation. One is grateful for Nagar's critical use of this body of data.

Many scholars use the accounts of various groups found in the colonial sources at their face value, ignoring the fact (pointed out by Nagar on p. 14) that they have varying degrees of reliability and were compiled by men of varying ability and objectivity—some of R. Temple's descriptions, for instance (p. 14) are plainly offensive. The very idea of some tribes being born "criminal" is, today, laughable—but it wrought terrible suffering on the defenceless and deracinated peoples concerned. (I wish Nagar had devoted some space to this in her otherwise sensitive and empathetic account of some groups.) No enumeration and ethnography of small clusters of families, constantly on the move and regrouping periodically, poor, and dispersed over the landscape, could have been rigorous in the nineteenth century (see pp. 11-14). Such groups were largely invisible.[1]

Volumes such as those put together by Crooke and by Russell and Hira Lal contain material gathered at different times and in different political and economic contexts: they cannot give us an idea of the dynamics of hunter-gatherer culture processes, or of how hunting-foraging survived as the habitat changed, as Nagar seems to suggest (p. 10). Besides, the imperative to enumerate and classify a set of colonial subjects inevitably meant that regional and cultural differences were overlooked, or that women's work and rights were not observed/understood, or that identity was not presented from the stance of the groups studied. The colonial sources did not always appreciate the fact that ethnonyms (such as "Gandhila") were labels bestowed by others on marginalized folk, as Nagar so rightly points out (pp. 10-11). They looked on tribal systems largely through the prism of landed property rights, as their main interest was in extracting land revenues.

I think the major contribution of Nagar's monograph is her profile of two groups, the Van Vagri of Rajasthan and the Pardhi of Central India . The value of this work does not lie only in their being contemporary accounts based on field observation. Neither does it lie solely in the sympathetic understanding of their existential problems in a modern India where all institutions of the state, including the election commission, ignore their existence or else brand them with the lowest of statuses. The fact is that the Van Vagri figure in no British gazetteer or census, and in no twentieth-century census either. (Perhaps this is why they are, by this account, a contented people.)

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[1] Similarly, mobile pastoralists hardly find a place in the nineteenth-century gazetteers of Kutch and Kathiawad.

The Van Vagri (pp. 43-58), it is argued, are an independently existing ethnic group. They own no land, live on village outskirts as crop-watchers or else in rough shelters in the jungle when they hunt and gather, in groups of three to five families. Despite their poverty they use a variety of traps, tools, and nets for catching birds and animals. The worship of *mata*s and the form their images take, the social role and the trance of the shaman, modes of dress and body ornamentation, are included in Nagar's description.

While the Van Vagris are not in the daily-wage-labour net, and do not constitute any kind of "caste", are not picked on by the administration as habitual offenders, and are not on the voters' lists, the Pardhi (pp. 62-86) (written about by Enthoven, Russell and Hira Lal, and others in the nineteenth century) who carry the baggage of having been branded a "criminal tribe" in the colonial period, have a panchayat (p 85) and have occasionally been recipients of patches of (rocky and stony) land (p. 86) unfit for agriculture. During fieldwork Nagar recorded the nature of Pardhi settlement and mobility, the social subdivisions of the group, its ancestor memorials, blood sacrifice, and "mother goddess" worship. Nagar's account is fresh and original, without stereotyping the beliefs or the religious content of the culture. The simple but effective devices for catching game, viz. traps of different shapes, nooses, slingballs containing explosive material obtained from manufacturers of firecrackers (never let it be said that they live like Mesolithic hunters!) and, equally ingenious, their birdcatcher's screen, are all documented. Pardhi women engage in the purchase and sale of bangles, and travel by bus to do this, leaving the children with the husband for a few days at a time (p. 83).

The question arises how the archaeologist can benefit from such studies (pp. 90 -99). Although I do not agree that we have a neat match between prehistoric times and today, the lesson for us is that through the past there was an *archaeologically invisible but economically important* sector at work even on the agricultural-surplus producing Ganga plain. I would go so far as to suggest that sometimes the bones of wild animals in a mound could have been the result of the hunting expeditions of hunter-gatherers living on the fringes of agrarian society, in the past as today. Certain crafts too could have been their work. The other very important point made in this volume is that an archaeological mark does get made (left behind) when several small mobile groups annually assemble in one place for ritual and social occasions.

Anthropologists may scoff at archaeologists for not residing with "their people" for the obligatory year-long period. Yet what we see here is that it is the intrepid archaeologist who, by going on the hunt with members of these groups, by documenting carefully their plant foods and mode of stalking and catching a partridge, by attending a wedding or two, and by engaging with hunters however insignificant their numbers, has given us an account of the social organization and material culture of groups who are regarded by officialdom as of no account, at best as a headache for the administration, and have never been given a place in the atlas and history of Indian peoples. Perhaps one day this monograph will be prescribed reading for our policy makers and administrators, and sensitize them to citizens such as these.

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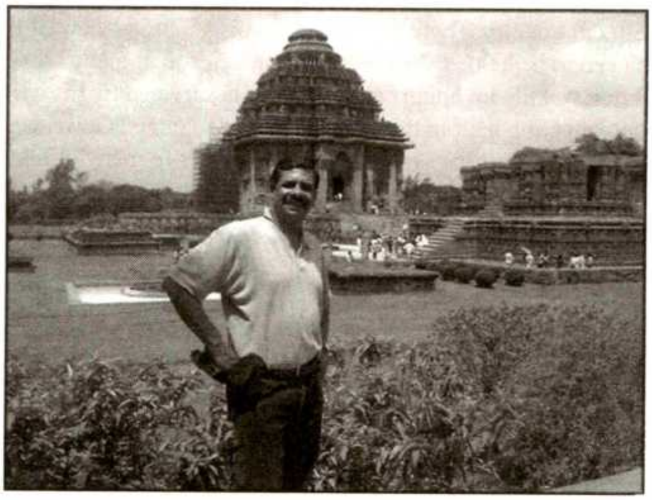
Obituaries



R. Balasubramaniam
(1961-2009)

Born on 15 April 1961 in Salem, Tamil Nadu, Ramamurthy Balasubramaniam had a brilliant academic carrier. A gold medallist in metallurgical engineering (B. Tech.) at the Institute of Technology, Banaras Hindu University (Varanasi), he pursued higher studies at the Rensselaer Polytechnic Institute (Troy, USA) where he obtained his Ph.D. in materials engineering in 1990. The same year, he joined the faculty of IIT Kanpur, eventually becoming a professor in 2001. In September 2009, he was nominated B.B. Lal Chair Professor at IIT Kanpur.

Prof. Balasubramaniam's multifarious interests in many areas of materials and metallurgical engineering led to the publication of 10 books, and over 250 papers in reputed journals. While his research won him many awards, what set him apart was his fascination for ancient India. It resulted in explorations into archaeometallurgy, a discipline which, in India, receives little institutional support. His pioneering findings on the role of phosphorus in the corrosion-resisting properties of ancient iron, as evidenced in the Delhi Iron Pillar and several others across India, won him fame and led to the publication of *Delhi Iron Pillar: New Insights* (Institute of Advanced Study and Aryan Books International, 2002) and *Story of the Delhi Iron Pillar* (Foundation Books, 2005). In 2007, Prof. Balasubramaniam together with his former student Gadadhar Sahoo re-created a phosphoric iron similar to that of the Delhi Iron Pillar and demonstrated its ability to resist rusting much longer than the best steels used in construction, with potential far-reaching consequences for concrete structures.

His meticulous study of the history and technical properties of Indian cannons resulted in *The Saga of Indian Cannons* (Aryan Books International, 2008). He also authored *Marvels of Iron Technology* (Rupa and Co. and Infinity Foundation, 2007), a wide-ranging and richly documented introduction to the topic.

In the last few years, Prof. Balasubramaniam turned his attention to ancient Indian metrology. I was privileged to exchange with him frequently on the fascinating problem of the linear units used at various stages of protohistoric and historical India, and in various architectural contexts. Building up on the units I had proposed for the fortifications of the Harappan site of Dholavira, he produced in his trademark rapid-fire fashion a series of papers (most of them published in *Man and Environment* and *Current Science*).

Bala, as he was known to his friends, impressed them with his boundless enthusiasm for knowledge and research and his one-pointed concentration on the task at hand. Hard-working to a fault, with apparently inexhaustible energy, he was also an active sportsman, an avid cricketer, an ace drummer and classical guitarist. These talents, besides an inspiring style of teaching and a warm-hearted, direct and informal personality, made him a highly popular figure on the IIT-Kanpur campus and beyond.

Interviewed in March 2009 by students of the Harcourt Butler Technical Institute, Kanpur, Bala responded thus to the usual questions on career prospects:

I do not think that the deciding factor can be such a thing as money alone. There should be something much greater as a goal in mind. As young people, all of you must have a dream — a vision to do something really great. Money is important but it is not the end. Have a much

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Some inputs from the obituary published on the website of IIT-Kanpur are acknowledged bigger goal in life to live for and work for. Unless you have a big dream, nothing will happen. .... You must also keep in mind how your dreams will help our country. There are so many unfortunate people who need to be helped. Just think of the number of small children waking up hungry everyday in India and with no hope of eating later in the day! What about them? Who will improve their lives? What is your education doing to lighten their burden? What can you do to bring a twinkle and cheer in their lives? Think how you can light a lamp in their lives. That is real development and that is something I really wish happens — a caring and loving educated youth worried about and taking care of the problems of the land.

Bala passed away a few months later, on 9 December 2009, carried away by a brief illness. He had been faithful to his generous view of life and accomplished more in his 48 years than many blessed with a longer stay on this earth. He is survived by his wife Dr. Gaitri Balasubramaniam and two daughters, Gowri and Gargi. His vision lives in them as it does in many of his friends and students.

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Frank Raymond Allchin
(1923-2010)

The death of Prof. Frank Raymond Allchin on 4th June 2010 at the ripe old age of 87 years brings more than one era in the sub-continental archaeology to a close. When Raymond was born around 1930, the Indus or Indus-Saraswati Civilization, one of the three Bronze Age civilizations (the other two being those of Nile valley in Egypt and Tigris-Euphrates valleys in Mesopotamia or modern Iraq), was just being discovered by the archaeologist's spade.

When Mahatma Gandhi died in 1948, Albert Einstein said, "Generations to come will scarce believe that such a one ever trod the earth in flesh and blood". With the passing away of Dr. F.R. Allchin, former Professor of Indian Archaeology at the University of Cambridge, U.K., the academic community, in particular those interested in the study of Indian history and culture, has lost an intellectual giant, the nearest example to whom was the historian A.L. Basham, formerly Reader in Indian History at Oxford University and later Professor in the same subject at the Australian National University, Canberra. Words spoken by Einstein about Mahatma Gandhi can almost equally aptly be applied to Prof. Allchin. With his death on 4th June, 2010, a venerable monument of Indian history and culture has fallen, and it will be generations before another one of his stature appears on the scene.

Dr. Allchin was a towering authority not just on South Asian Archaeology but on South Asian Studies in general. His knowledge of South Asia's past was truly encyclopaedic, covering ancient as well as medieval and modern periods of history, and particularly archaeology. He was the most outstanding European archaeologist to have devoted his entire academic life to the pursuit of the past of South Asia, specially of India, Pakistan and Sri Lanka.

Dr. Allchin had a degree from Cambridge in South Asian History and Archaeology. During the Second World War, he served in the British Indian

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Photo: Courtesy Professor K. Paddayya.

Army, and acquired a good working knowledge of Telugu, and considerably improved that of Hindi. He translated Tulsidas' *Kavitavali* and a couple of other Hindi texts into English. Raymond was married to Bridget who, herself is an archaeologist of no mean repute. She and Raymond made an ideal pair, both as husband and wife, and as archaeologists. Their specializations were of a complementary nature. While Bridget specialized in the study of prehistory, Raymond's expertise was in protohistory and historic archaeology, both of them making an occasional digression into Ethnoarchaeology. South Asia was their geographical area of field work.

As the research of both Ramond and Bridget was based on field work, they were visiting India, Pakistan, Sri Lanka or Bangladesh almost every year for conducting field work, and for Raymond to brush up his knowledge of Telugu and Hindi. During the 1950s, Raymond excavated the Neolithic sites of Piklihal in Raichur district of Karnataka and Utnur in Mahbubnagar district of Andhra Pradesh, the latter in former Nizam's Princely State of Hyderabad which had one of the best Archaeology Departments in the country. Both these sites represent the earliest stage of food production and permanent occupation known as Neolithic in contrast to food-gathering and nomadic stage known as Palaeolithic and Mesolithic. They are located in the semi-arid region (annual precipitation below 500 mm.). Rainfall in this region is not only insufficient but also erratic and unreliable, and therefore inadequate for plant agriculture as the principal mode of economy. Even today with facilities for irrigation steadily improving, plant agriculture remains unreliable as a source of food and most people are dependent on animal husbandry, particularly raising of cattle, sheep and goats. The excavated remains at these sites yielded abundant quantities of bones, teeth, and horn cores of these animals as well as of wild animals, including antler pieces of several deer species, thus testifying to inhabitants' dependence on wild food.

At Utnur the site consisted of a heap of ash, which was the product of periodical and ceremonial burning of accumulated cattle dung. Allchin produced reports of these excavations which were published by the Archaeology Department of Nizam's government. He also located a large number of similar ash heaps, known to archaeologists as ash mounds in the semi-arid region of Andhra Pradesh, Karnataka and Tamil Nadu. The names of these heaps usually have the prefix *Budi,* meaning ash. One such site, Budihal in Gulbarga district of Andhra, excavated by Prof. K. Paddayya of the Deccan College, Pune, has produced charred remains of wattle huts, enormous quantities of charred and uncharred animal bones, a large butchering floor with heaps of cut and charred bones of slaughtered cattle, hand-made grey-coloured pottery, and skeletons of adult and infant humans buried in pits dug in the earth or in clay pots with their mouths tightly closed by touching each other. Allchin also collected ethnographic evidence about cattle being penned at night in enclosures of wooden sticks and thorns. Even today heaps of cattle dung in these enclosures are ceremonially burnt to clear the ground of insects and other vermin. Cattle bones were also used for making tools like axes, scrapers, points for spears, arrowheads, etc. The best examples of highly polished such tools have been found at the site of Palavoy in Mahbubnagar district excavated by V. Rami Reddy who got a Ph.D. degree on his work from Poona University under my supervision in 1972. Prof. Allchin was one of the external referees of Reddy's dissertation.

Dr. Allchin also conducted excavations at Taxila in Pakistan and at Anuradhapura, the ancient capital of Sri Lanka. He was a teacher par excellence and taught and supervised the Ph.D. research of several generations of students from South Asian countries. His students have occupied prestigious positions in South Asian universities and Government Archaeology Departments. Dr. Allchin was an excellent scholar of Sanskrit and Hindi and spoke chaste Hindi. He translated Tulsidas' Kavitavali and other books into English. When I first met him in his office at Cambridge University, he bowled me over by greeting me in chaste Hindi, and discussed the work I was doing in India as well as Reddy's work with genuine enthusiasm and interest. During the two months or so that I was in Cambridge, the Allchins invited me several times for lunch or dinner at their elegant home in the country outside Cambridge. They also invited several other Indians who they knew or I recommended.

Mrs. Allchin is one of the chief architects of the prestigious organization, European Association of South Asian Archaeologists, which holds its biannual conference in one of the European countries and to which select archaeologists from South Asia are invited. I was privileged to be invited to their conferences held under the auspices of IsMeo at Rome, Italy, University of Denmark at Aarhus, University of Finland at Helsinki, and Cambridge University at Cambridge.

Individually or jointly, the Allchins have authored or edited several famous books like *The Neolithic Cattle Keepers of South India, Birth of Indian Civilization, Beginnings of Civilization in India and Pakistan, The Stone-Tipped Arrow,* and *Origins of Civilization.* Their books are treated as authorities on the subject and are extremely popular with archaeologists as well as with non-specialist readers.

I had known Dr. Allchin very closely for over fifty years, and had met him on numerous occasions in England and other European countries as well as in India and Sri Lanka. Both of them had stayed in my house in the Deccan College and had endeared themselves to my wife, children, and maid. I myself had enjoyed Allchins' warm hospitality at their home in Cambridge and in the Faculty of Oriental studies where Raymond worked as well as in the College where Bridget worked. I also had the privilege of receiving all their publications – reprints of articles in journals and edited volumes as well as individually or jointly authored or edited books immediately after their release. When they were planning the second edition of their *Birth of Indian Civilization,* they asked me to give my comments and suggestions on the first edition which I was happy to give.

The Allchins, particularly Raymond, were very warm-hearted and hospitable, and had sincere respect for South Asian peoples and their cultures. In fact, because of their long and close association they regarded the Indian subcontinent as their second home and missed no opportunity of visiting it. They had many students and a large number of valued colleagues and friends there, with some of whom they had developed close family bonds.

Raymond will be missed and fondly and respectfully remembered by his many students, colleagues and friends in the Indian subcontinent as long Indian studies continue, and his considerable academic output will continue to serve as a source of teaching long after his mortal frame is gone. He was a true *guru* in the venerable Indian tradition and will continue to be so regarded by many generations of future Indian students. Teachers and scholars like Raymond are born but rarely

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Katy Feroze Dalal
(1942-2010)

Katy Feroze Dalal (nee Nariman Frenchman) was an unusual person. Remarkably courageous, bold and confident from her childhood, she was a born leader and would not be intimidated or taken for a ride by anyone, howsoever important and powerful. She met everyone on equal terms and did not mince words in expressing her opinion of a person or situation. She met stalwarts in archaeology like H.D. Sankalia, A. Ghosh, Sir Mortimer Wheeler, Robert H. Dales, Raymond F. Allchin, Robert H. Dyson, and Mohammad Rafique Mughal and confidently discussed her research with them.

Katy did her B.A. with Ancient Indian History and Culture from the K.C. College, Bombay

University, and decided to pursue a career in archaeology even while she was still a student. She later did her M.A. and Ph. D. in Archaeology from the Deccan College, Pune.

After getting her M.A. degree, Katy decided on her own to do Ph.D. under my guidance. She chose her topic – `The Indus Civilization in the Ghaggar valley in the Ganganagar district of Rajasthan'. For this topic she had to conduct exploration for locating Harappan and other settlements along the bed of the Ghaggar in the smuggler infested and sparsely populated Ganganagar district bordering Pakistan. It was a highly challenging and risky job, particularly for a pretty young lady. But Katy accepted the challenge with great enthusiasm. Fortunately, through her family contacts the intrepid Katy was able to enlist the support of K.F. Rustomji, the dynamic first Director-General of the Border Security Force (BSF). Shri Rusomji provided Katy a jeep and a trusted driver. In this vehicle, Katy and I were able to travel along the long border in the Ganganagar district, and, with the help of local cattle herders, relocate the Protohistoric (Hakra Ware, Early, Mature and Late Harappan, and Painted Grey Ware (PGW) and Early Historic (Rang Mahal or Kushana), sites in the desolate, sand dune covered and sparsely populated land. There were hardly any large and truly permanent villages in the area, and few metalled roads. The small population lived in wattle huts and subsisted on cattle, goats and sheep in a land where potable water was a scarce commodity.

Katy also conducted excavation on the Early and Mature Harappan mound at Binjor in the Anupgarh Tahsil. The mound, surrounded by yellow mustard fields, prominently stood out in the otherwise barren landscape. The excavation, even though small in size, produced extremely interesting results, including Hakra Ware pottery which antedates the Early Harappan culture. Katy was helped in her excavation by her friendly father-in-law, and Dr. Z.D. Ansari, a faculty member of the Archaeology Department of the Deccan College. It speaks volumes for Katy's courage to have undertaken field work in such an inhospitable area.

After getting her Ph.D., she taught Ancient Indian History and Culture at a couple of colleges in Bombay, including her *alma mater.* She published a few original and important papers based on her field work and reading. However, she could not get a permanent job, and could not pursue her research career.

Katy was extremely helpful and would go to any length in helping the persons she liked and respected. She was extremely affectionate and generous by nature, and had a motherly and protective attitude to people close to her. I have many happy memories of my interactions with Katy, and will always cherish them.

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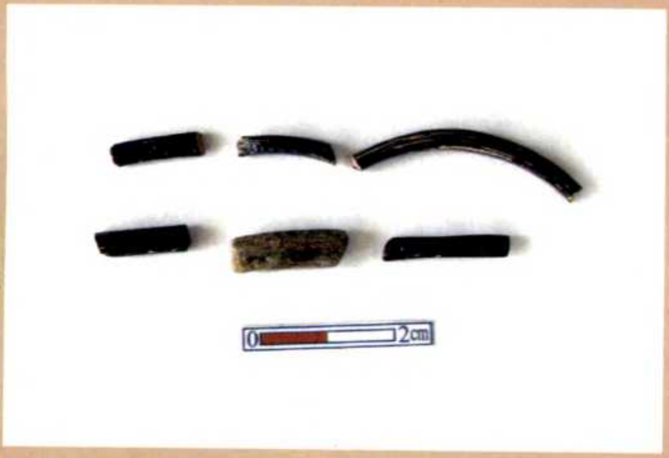

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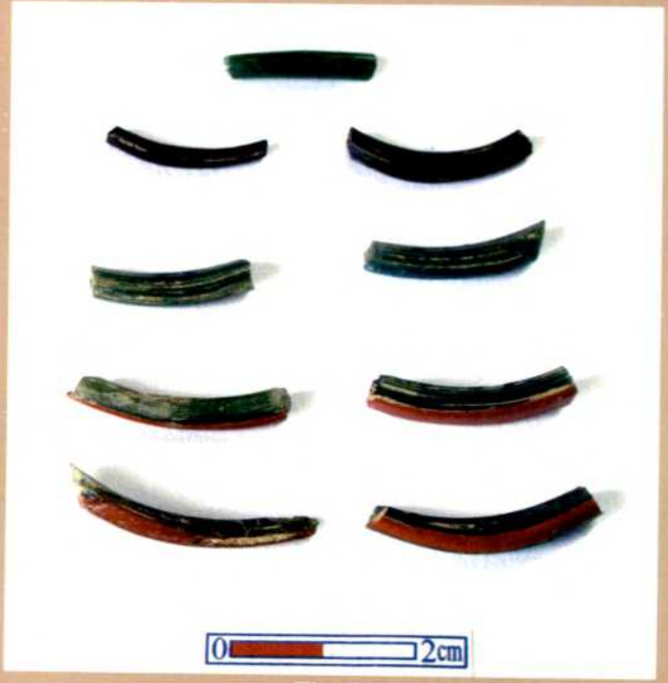

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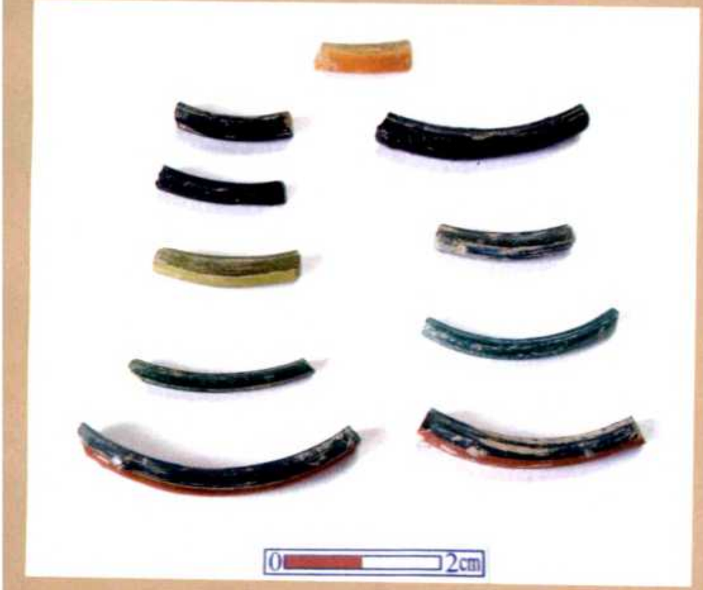

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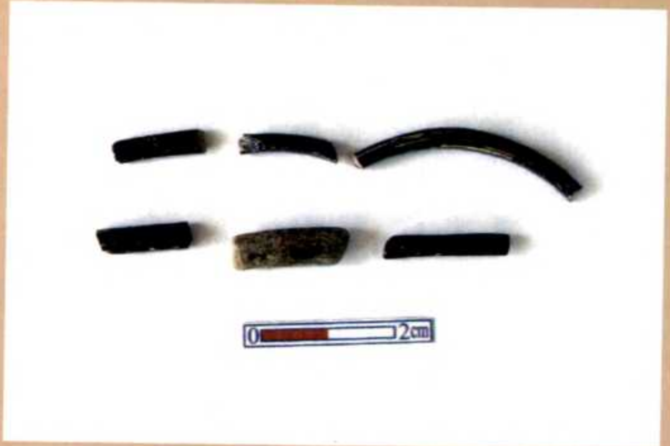

Fig. 4

Glass Bangles from PGW Period

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Articles and Notes

1. **Relevance of Archaeology for Studies in Recent History**
S. Nagaraju 1

2. **Status of Archaeology of the Middle Ganga Valley: Stone and Early Iron Age Cultures**
Vidula Jayaswal 8

3. **Systematic Transect Survey of the Jurreru Valley, Kurnool District, Andhra Pradesh**
Shipton, C.B.K., B. Janardhana, J. Koshy, M.D. Petraglia, M. Haslam and R. Korisettar 24

4. **Changing Patterns of Settlement in the Rise and Fall of Harappan Urbanism and Beyond: A Preliminary Report on the Rakhigarhi Hinterland Survey 2009**
R.N. Singh, C.A. Petrie, V. Pawar, A.K. Pandey, S. Neogi, M. Singh, A.K. Singh, D. Parikh and C. Lancelotti 37

5. **Mitathal: New Observations based on Surface Reconnaissance and Geologic Provenance Studies**
V.N. Prabhakar, Tejas Garge, Randall Law 54

6. **Ecological Continuity: An Explanation for Agricultural Diversity in the Indus Civilization and Beyond**
Steven A. Weber, Tim Barela and Heather Lehman 62

7 **Faunal Remains from Jaidak (Pithad), a Sorath Harappan Site in Gujarat**
P.P. Joglekar and Pankaj Goyal 76

8. **Faunal Remains from the Iron Age and Early Historical Settlement at Mahurjhari, District Nagpur, Maharashtra**
Arati Deshpande-Mukherjee, P.K. Thomas and R.K. Mohanty 87

9. **A Study of Glass Bangles from Abhaipur, District Pilibhit, Uttar Pradesh**
Anup Mishra, Deepak Singh and Anuj Sharma 103

10. **Note on a Microlithic Site at Judwani, District Sonbhadra, Uttar Pradesh**
Vibha Tripathi and Prabhakar Upadhyay 109

11. **Note on "A Gazetteer of Pre- and Protohistoric Sites in Gujarat", XXXII (2): 61-136**
S.V. Rajesh and Ambika Patel 112

Book Reviews

12. **Archaeology and Text: The Temple in South Asia** 118
M.K. Dhavalikar

13. **The Palaeolithic Settlement of Asia**
Sheila Mishra 119

14. **Excavations at Sisupalgarh, Orissa**
P.P. Joglekar 122

15. **Maritime Archaeology for Beginners**
Alok Kumar Kanungo 123

16. **Hunter-Gatherers in North and Central India: An Ethnoarchaeological Study**
Shereen Ratnagar 124

Obituaries

17. **R. Balasubramaniam** 127

18. **Frank Raymond Allchin** 128

19. **Katy Feroze Dalal** 130

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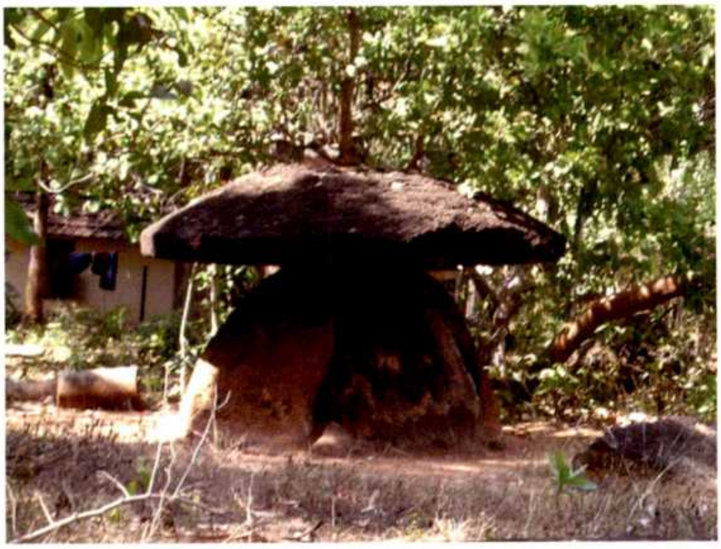

Fig. 3: Umbrella Stone, Cherumangad

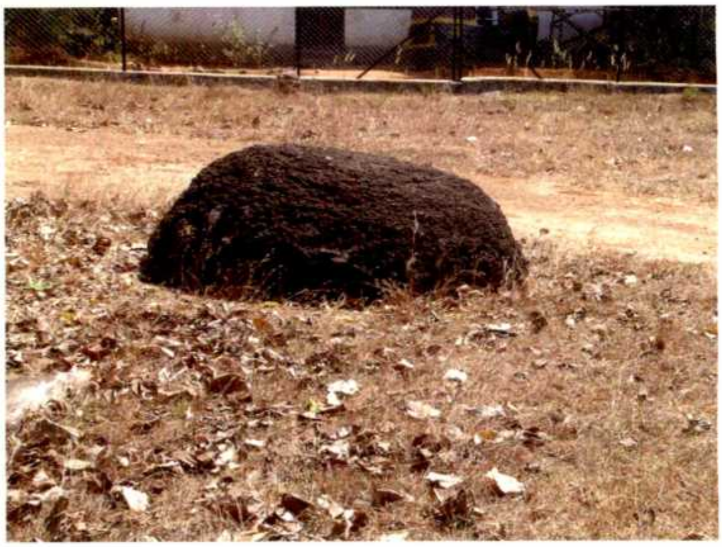

Fig. 4: Hat stone, Cherumangad

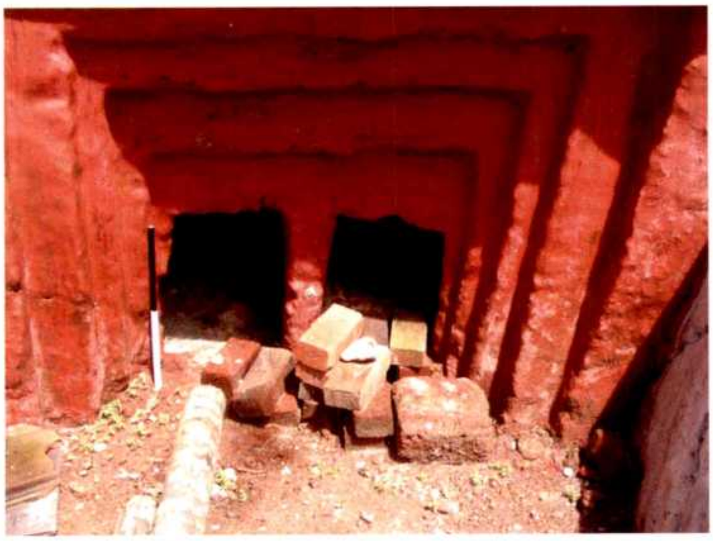

Fig. 6: Rock cut cave, Punnol

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Man and Environment

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Editorial

We believe that the readers of *ME* are aware that all contributions submitted to *ME* are refereed. The Journal strictly maintains the anonymity of the contributors and referees. Once the referee gives his/her comments, these are sent to the author for making necessary corrections and modifications in his contribution. The Editorial Committee makes every effort to incorporate the observations of the author and the referee in finalizing the contribution for publication. Reaction to the referee's comments in an objective manner reflects the academic integrity of the author. However, we regret to note that some authors do not react in this academic spirit and attribute motives to the referee and the editors if: (a) there is delay in taking a decision on their contribution; (b) drastic modifications are suggested in it; and (c) it is not accepted. We would like the authors to appreciate that the referees have their own academic commitments and other demands on their time. They are discharging their duty in a purely honorary capacity. The referees do their job as a commitment to the journal; the editors cannot compel them to expedite their comments.

We ask the contributors to appreciate that the editors have their own academic commitments and are performing a thankless job deriving satisfaction, indeed happiness, in the knowledge that their work is appreciated by the readers. We request the contributors to send us their reactions, in not more than 250 words on individual articles as well as on the issue as a whole. We will publish their comments in the succeeding issue, and hope that these will help improve the quality of the Journal. We look forward to receiving the reaction of the readers to this proposal.

The first paper of this issue by James Blinkhorn and others is related to their reconnaissance survey conducted in the Katavani Kunta Valley in Kurnool District of Andhra Pradesh. Adam S. Green, presents a new methodology for reconstructing the operational sequences used by seal carvers of the Indus civilization (2600-1900 B.C.). Using experimental replication and microtopographic analysis, the operational sequences used to produce two seals from Chanhu-daro are reconstructed.

In continuation of his earlier studies of a proposed system of linear units for Dholavira's elaborate town-planning and the specific proportions for its successive enclosures, Michel Danino discusses objections to the proposed systems, and presents fresh evidence on the accuracy of the published dimensions of Dholavira's fortifications.

Reshma Sawant reviews the progress of archaeological studies in Protohistoric and Historical Archaeology of Vidarbha during the Colonial and post-Colonial periods. Ashok Marathe and his colleagues give results of geophysical investigations comprising the Seismic Refraction, Electrical Resistivity Imaging. GPR surveys were conducted to observe the nature of strata and to uncover buried artefacts at Kelshi.

S.B. Darsana's article presents an overview of Kerala megaliths, analysis of megalithic burial monuments along with grave goods, and proposes a new typological system for the megalithic burials of Kerala. H. Chandrashekhar's short article reports new discoveries of rock bruisings, mainly of the Chalcolithic period, in Maladkal; and megalithic menhirs in Hireboodur in Raichur district of Karnataka.

The issue of antiquity of iron and its advent in the Ganga Plain is being debated in recent years after finding new early evidence of iron. Some scholars have refuted the evidence on various grounds. Rakesh Tewari's paper deals with these doubts in light the new evidence.

The publication of this Journal has been financially supported by the Indian Council of Historical Research (ICHR) and the Archaeological Survey of India (ASI). The responsibility for the facts stated, opinions expressed, or conclusions reached is entirely that of the contributors of the articles. The ICHR, ASI and the Indian Society for Prehistoric and Quaternary Studies accept no responsibility for them.

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Cover: Rock Paintings at Maladkal, Karnataka

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Systematic Transect Survey Enhances Investigations of Rock Art in its Landscape Setting: An Example from the Katavani Kunta Valley, Kurnool District, Andhra Pradesh

James Blinkhorn, Janardhana Bora[1], Jinu Koshy[1], Ravi Korisettar[1], Nicole Boivin and Michael Petraglia

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Abstract

A reconnaissance survey conducted in the Katavani Kunta Valley, Kurnool District, identified a significant concentration of rock art sites in a narrow upland valley immediately north of the Jurreru River Valley. However, this reconnaissance provided little data relating to the broader archaeological landscape in which this body of imagery is situated, or the spatial distribution of sites throughout the valley. A systematic transect survey was subsequently designed and undertaken to examine these factors. The results of this survey show a richer archaeological landscape and a greater spatial diversity of sites then was previously known. Further to this, a comparison of different survey techniques shows that systematic transect techniques provide an accurate model with which to characterise this archaeologically rich valley and an important methodological tool for investigating rock art landscapes in general.

Introduction

The rock art of India is rich and varied, and has been a subject of study for over a century (Bednarik and Chakravarty 1997; Chandramouli 2003; Cockburn 1883; Mathpal 1984; Neumayer 1993; Sankalia 1978; Wakankar 2005). However, much rock art in India remains either unknown or understudied, particularly with respect to its geographical and archaeological context. This article illustrates how systematic methodological approaches to rock art survey can vastly enhance data available for investigating the spatial diversity and archaeological site composition of rock art landscapes, and thus shed light upon the various ways humans have incorporated different aspects of the physical world into their social lives through time. Systematic transect surveys of the Katavani Kunta Valley, Kurnool District, Andhra Pradesh have transformed our understanding of the archaeological context of the rock art in the area, in comparison to an earlier 'roadside' reconnaissance method.

Background

The Kurnool District, Andhra Pradesh, is located in South India (Fig. 1) and has been considered a rich and important location for the study of Indian prehistory for over 150 years, with evidence of near continuous occupation from the Acheulean stage (Cammiade 1926; Cammiade and Burkitt 1930; Clarkson *et al.* 2009; Foote 1884; Isaac 1960; Murty 1974; Murty and Thimma Reddy 1976; Newbold 1844; Petraglia *et al.* 2007; 2009). The Katavani Kunta Valley is a small upland valley, named after the village it contains, that runs on a NW-SE axis cutting through a quartzite plateau at the southeastern edge of the Erramalai range. Numerous large quartzite boulders litter the slopes of this valley, particularly toward its southeastern end (Fig. 2). The valley drops away suddenly at its southeastern terminus, into a small, subsidiary valley, containing the Yaganteshwara Swamy temple, which was built in the 15th century.

Under the Kurnool District Archaeological Project after an initial survey, and a follow-up survey, a third field season was undertaken with three specific objectives:

1. to situate the rock art sites previously identified in the Katavani Kunta valley within their broader archaeological context;
2. to understand the spatial diversity of both rock art sites and other archaeological sites throughout the Katavani Kunta Valley; and

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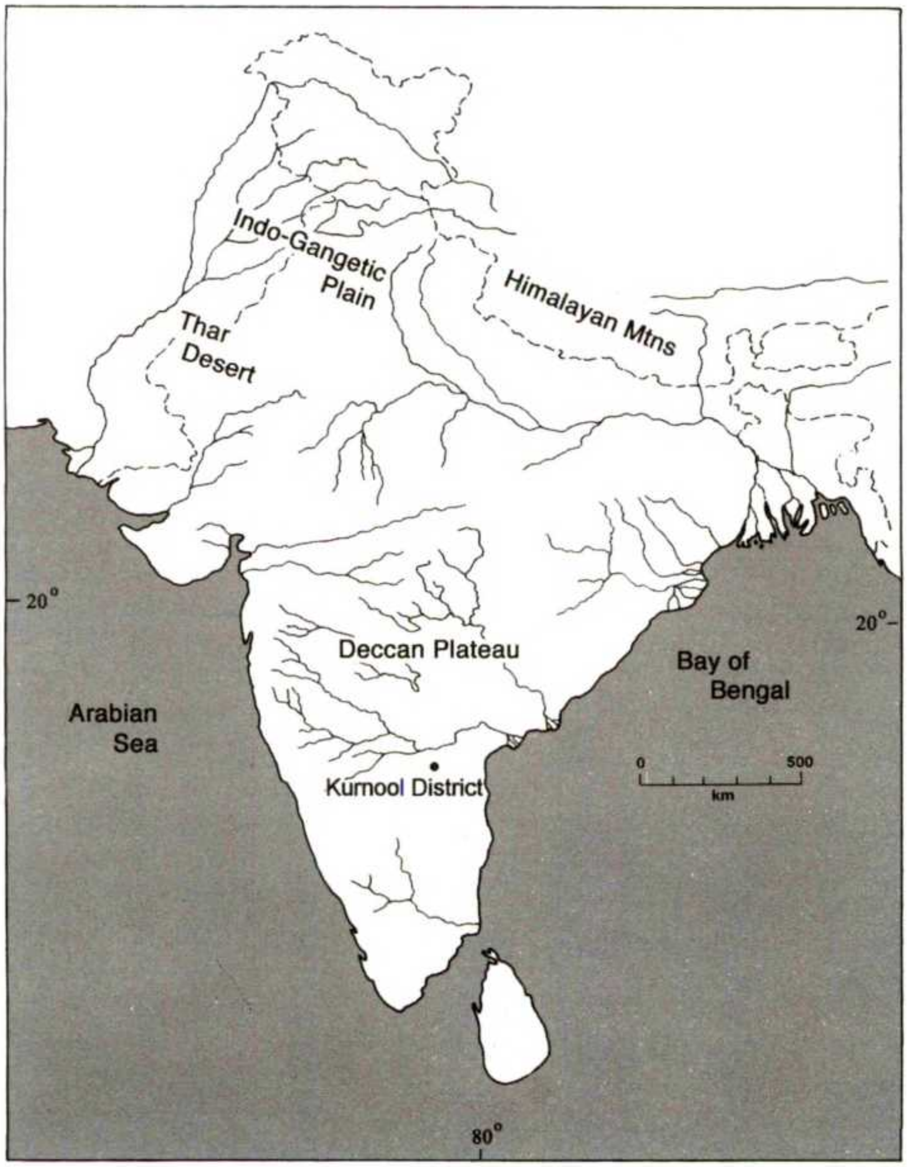


Fig. 1: Map showing location of Kurnool District in India

3. to investigate the validity of different survey techniques for accurately characterising a rock art landscape.

The Reconnaissance Surveys

In the early stages of the Kurnool District Archaeological Project, an exploratory survey was conducted in the Katavani Kunta Valley to prospect for archaeological sites and this has resulted in the identification of a number of rock art sites. This survey focused attention on a limited number of rockshelters close to the road running along the valley floor. This survey was preliminary, and, as a result of the identification of a dense cluster of rock art sites, a second season of survey was conducted. The follow-up survey involved the use of a more detailed recording methodology, developed specifically for rock art, as well as limited further exploration away from the valley floor. Together, these surveys identified 26 sites in the Katavani Kunta Valley (Table 1), 25 of which included rock art, some associated with other archaeological phenomena, and a single site containing only lithic artefacts, in a number of locations throughout the valley (Table 2)

Ten rock art sites include a distinctive corpus of white painted V-shaped or trident images (Fig. 3) that have been linked to 'modern' religious activities, with a modern local shrine in place at the most

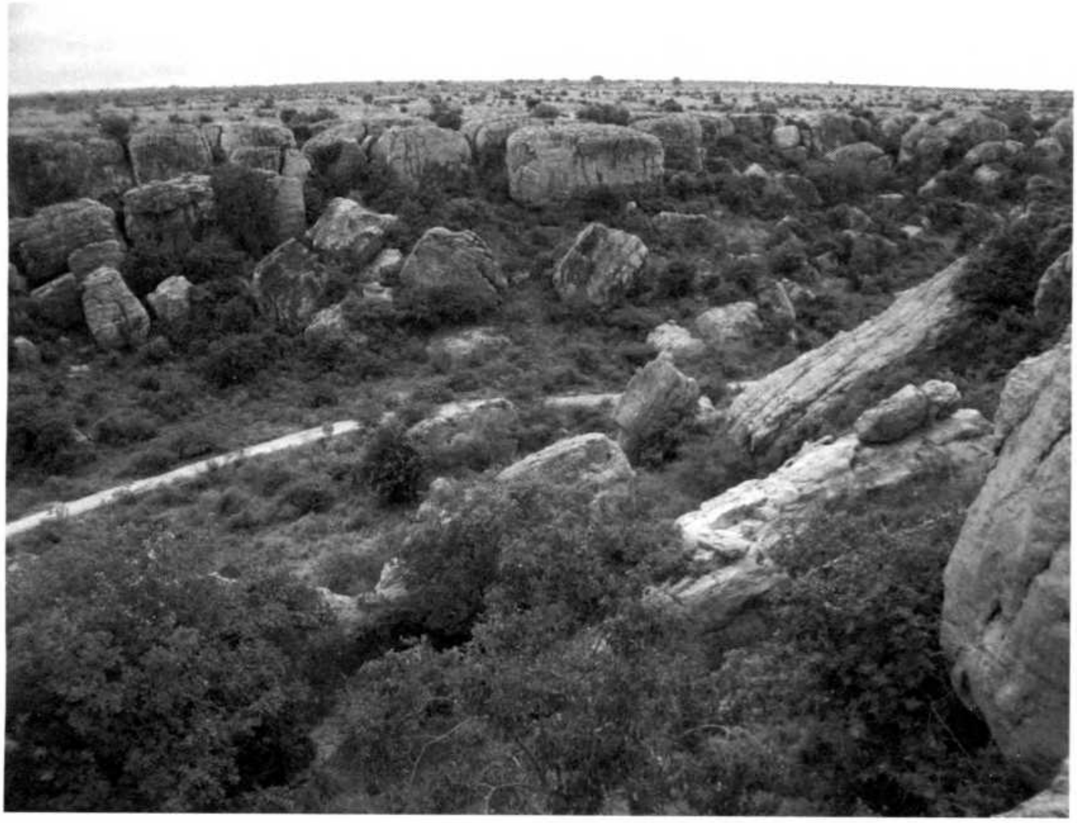


Fig. 2: Katavani Kunta Valley slopes with numerous quartzite boulders

densely painted site. A further two sites contain engravings with religious imagery. Two of these sites also contain red painted images; at one of these sites red paintings are more numerous, whereas at the other sites only remnants of red painting were recorded. These sites are thought to relate to recent religious activities connected with the Yaganteshwara Swamy temple. Although no archaeological deposits were recorded at these sites, evidence of recent ephemeral occupation and ethnographic enquiries indicate that this body of imagery was created by people travelling along the pilgrimage route through the Katavani Kunta Valley to the Yaganteshwara Swamy temple, and it is suggested that much of this imagery is less than 500 years old (Boivin *et al.* 2009; Taçon *et al.* 2010). Two sites were identified with white painting with no clear religious associations in the imagery itself, although at one site a number of red and white figures are seen in a rock shelter containing a modern local shrine.

Fourteen sites contain red painted images, of a type that have traditionally been linked to microlithic societies (e.g. Misra 2001), three of which have already been mentioned above. These sites range from densely painted panels, where the concentration of painting makes the identification of individual images difficult (Fig. 4), to single images on rock shelter walls. The images at these sites are varied and include anthropomorphic, zoomorphic and geometric figures (Boivin *et al.* 2009). Global studies have indicated that when red ochre (iron oxide) is used as a pigment, it is often the case that no physical trace of paint is left on the rock surface: rather, what is visible is the staining of the rock surface itself through capillary action (Chippindale and Taçon 1998; Whitley 2001). Given this likelihood, it has been suggested that some of the Katavani Kunta Valley red imagery may be of significant antiquity, although variable degrees of fading indicate that some of it is likely to be more recent (Boivin *et al.* 2009).

The discovery of the Katavani Kunta Valley as a rich location for rock art imagery emphasises the continuing need for archaeological survey, even in areas with a long history of study such as the Kurnool District. The detailed recording of this body of rock art by the reconnaissance surveys allows for various forms of analysis to be undertaken, which can lead to inferences regarding the authorship and chronology of these images. However, both surveys maintained a narrow focus on locating and

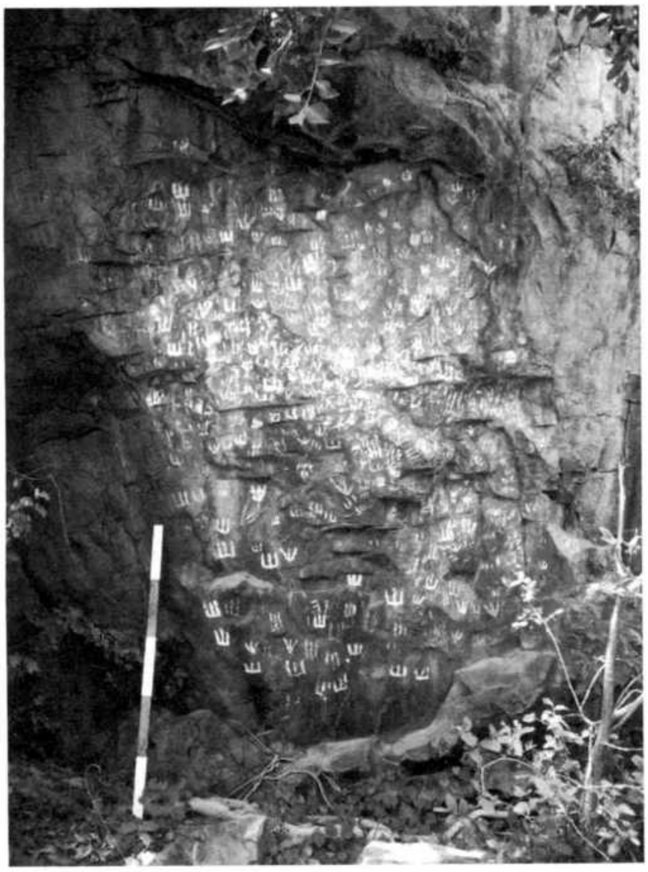


Fig. 3: A site with numerous white painted images, linked to recent local level religious practices

recording rock art sites, rather than identifying and recording all forms of archaeological phenomena. It was realised that this approach produced a limited knowledge of other forms of archaeological record present in this valley, which has implications for understanding the context of production of rock art sites and particularly its chronology. Furthermore, neither survey investigated the spatial distribution of sites in a systematic manner, focusing instead on sites that were relatively easy to access. This resulted in a skewed understanding of the geographical diversity of rock art sites thereby leading to a distorted interpretation of why rock art sites are located where they are. These surveys provided only limited information suitable for the 'formal' analysis (Taçon and Chippindale 1998) of rock art in this valley, i.e. the study of rock art without any information from the creators of the imagery and their contemporaries, and thus our ability for understanding variability in the rock art traditions in this area is reduced.

The Systematic Transect Survey

To address the limitations of the previous surveys, a systematic transect survey was devised to sample 20% of the slopes of the Katavani Kunta Valley. The aim of this survey was to understand the nature of surface archaeology in the valley, and its spatial distribution, in order to situate the known rock art sites in a broader archaeological and geographical context. The survey was undertaken by three members of the Kurnool District Archaeological Project with the support of a local person.

Methods

The method employed in this survey involved walking 165 transects, from the base to the top of the valley slopes, each spaced 50 m apart along the entire length of the valley, roughly 3 km in length. The orientation of these transects was established using a compass, and where possible a Global Positioning Satellite (GPS) device, and a 50m measuring tape was used to ensure the given alignment was followed (Fig. 5). Any form of archaeology found up to 5m on either side of the transect line was included, effectively sampling 20% of the valley slopes. All archaeological remains were recorded and photographed, while the locations of finds was established using a GPS device, as well as noting its relative position upon the transect. When large, quartzite boulders blocked the path of a transect, a system of off-setting was employed, in which a series of measurements and compass readings were used to ensure that the transect could be continued on the same alignment on the other side of a boulder. In addition to the sites located on the transect line, any archaeological sites found while travelling between transects or beyond the 10 m transect bracket were also recorded to allow for a wider picture of the spatial and archaeological diversity of sites. For the purposes of analysis, the information derived from transects has been maintained as a discrete data set, while sites located between transects have been combined with the systematic transect survey data and the reconnaissance survey data to create a total data set for the Katavani Kunta Valley.

The valley floor was not included in this survey since the majority of it is cultivated land, and the survey was conducted while a number of crops were close to harvest. Two factors limited the effectiveness of the systematic transect survey: firstly, limited satellite coverage hampered the accuracy of the

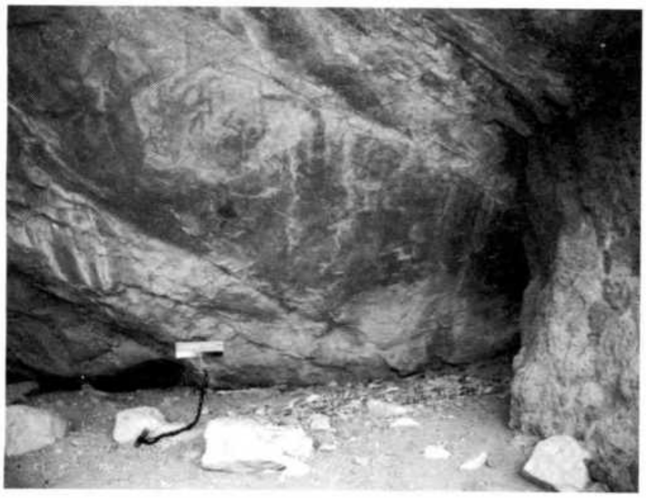


Fig. 4: Site KK1 with very dense red painted images

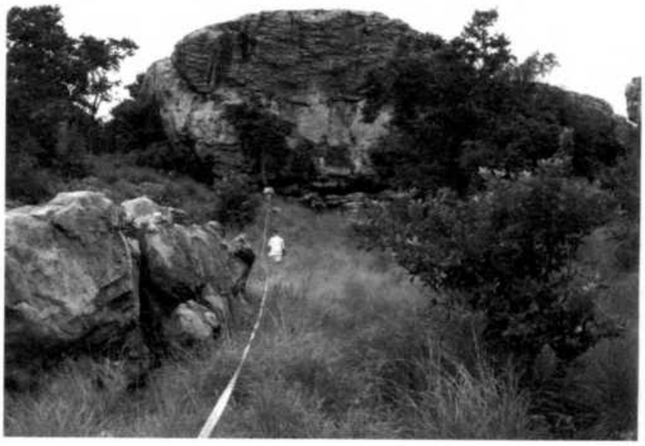


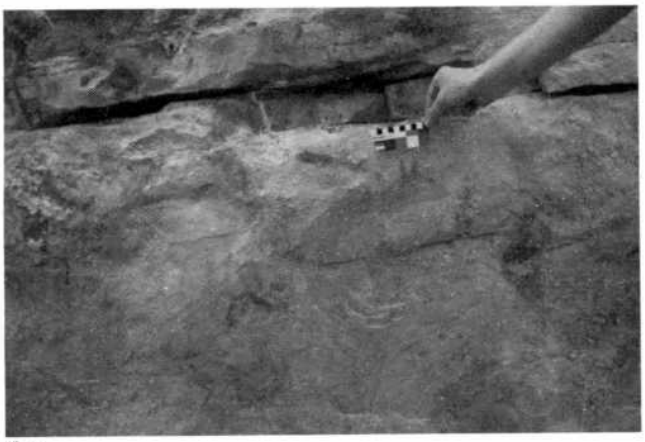
Fig. 5: Survey in progress with tape stretched out along transect line

GPS readings and as a result records of the relative positions of sites have proven useful in analysis; secondly, in some areas high vegetative growth during the season and year of fieldwork reduced ground visibility and so in a limited number of cases single artefacts were recorded as sites where exploration in that vicinity was too difficult.

Results

A total of 38 archaeological sites were identified through the systematic transect survey of the Katavani Kunta Valley, including 19 sites with rock art, of which 7 were already known. The employment of systematic transect methodologies enabled identification of a broader range of archaeological phenomena than did reconnaissance techniques, as well as a greater variety of associations between different types of archaeology (Table 1). At one site that had been identified by the reconnaissance survey a new category of material culture was recorded, as a result of focus on surface archaeology as well as rock art. Four main categories of material culture were encountered during the systematic transect survey; these were rock art, stone structures, ceramics, and lithics (Fig. 6a-d)

Rock art imagery with clear recent religious affiliations is only seen at 3 sites located by the systematic transect survey, all of which were previously identified by the reconnaissance surveys. Sites with red painted rock art imagery are most numerous (n=15) and further sites (n=3) with white painted images with no clear religious affiliation were recorded. Some sites (n=2) contain red images that appear to have been drawn using ochre crayons. Two sites containing black painted images were identified. A variety of stone structures bearing some similarities to Megalithic burial structures and dissimilar to the shrines located by the reconnaissance survey were identified. These included cairns, cists, and semicircular walls abutting rock shelter walls; all were made from locally available materials. Sites containing ceramic assemblages were common, and often associated with other types of archaeological record, including rock art. Ceramic pieces bearing typological affinities to wares known from the Late Neolithic to Late Iron Age are numerous in the Katavani Kunta Valley, whereas very few ceramic pieces from the historic period were located (Blinkhorn 2008; Dorian Fuller: personal communication 2007). Sites with lithic assemblages usually contained microlithic technologies, and only a few sites included larger flake and blade pieces in their assemblage. At three sites ground stone pieces were recorded. These finds provide potential chronological indicators for heightened periods of human activity in the Katavani Kunta Valley - a peak of human activity appears to have occurred during the Iron Age, although this does not preclude significant earlier activity. As a result, it is possible to suggest that some of the rock art in the Katavani Kunta Valley was produced in this period. Furthermore, the appearance of stone structures with no clear utilitarian function in this valley, alongside a rich rock art record, may suggest that this valley was a focal point for symbolic activity within this region, although further survey is needed to test this hypothesis.



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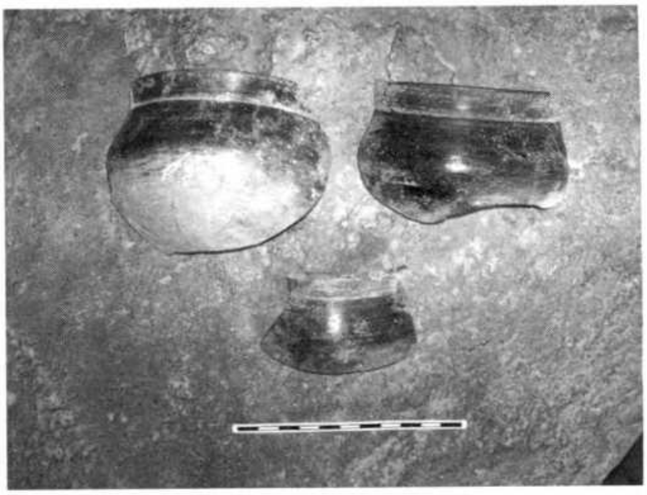

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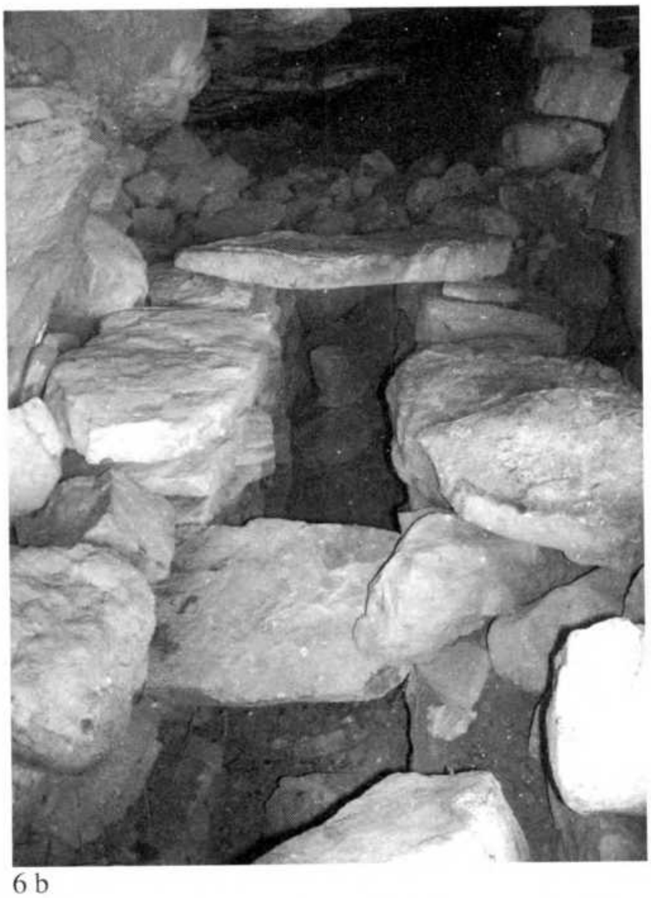

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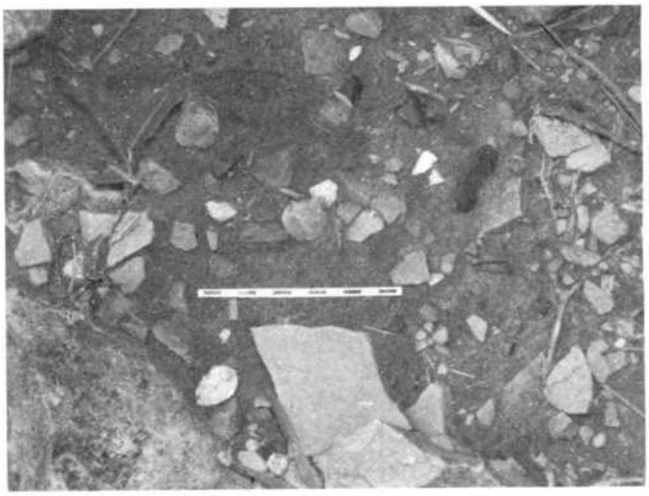

6 d

Fig. 6 Examples of each type of material culture encountered on the systematic transect survey; a) red painted and crayon drawn rock art; b) a cist; c) a ceramic assemblage; d) a microlithic assemblage

The spatial distribution of these sites is more varied than was recognised from the reconnaissance surveys (Table 2). The latter identified the lower portion of the northeast facing valley slope as a concentration of archaeological sites, suggesting a relative lack of sites in other areas. The systematic transect survey shows a more even distribution of sites across the valley slopes indicating that the previous surveys gave an incomplete understanding of the spatial distribution of sites in the valley. The reconnaissance survey did, however, identify a number of clusters of sites, all of which are broadly located in the southeastern end of the valley (Fig. 7), where there is a greater concentration of quartzite boulders. This pattern is corroborated by the systematic transect survey (Fig. 8) which revealed a more diverse archaeological landscape providing a richer context for interpreting the rock art imagery.

In addition to the sites mentioned above, a further group of 31 sites were located and recorded in

Table 1: Percentage frequency of sites identified in the Katavani Kunta Valley with different types of material culture by the reconnaissance surveys, the systematic transect survey and all known sites; actual frequency of sites is shown in brackets

Type of material culture	**Reconnaissance Survey (%)**	**Systematic Survey (%)**	**All Known Sites (%)**
Rock art	77 (20)	18.4 (7)	35.2 (31)
Rock art and lithics	7.7 (2)	5.3 (2)	5.7 (5)
Rock art and ceramics	3.8 (1)	15.8 (6)	7.9 (7)
Rock art and structures	7.7 (2)	2.6 (1)	3.4 (3)
Rock art, ceramics and lithics	0 (0)	5.3 (2)	2.3 (2)
Rock art, ceramics and structure	0 (0)	2.6 (1)	1.1 (1)
Rock art, structure and lithics	0 (0)	0 (0)	1.1 (1)
Ceramics	0 (0)	15.8 (6)	12.5 (11)
Ceramics and lithics	0 (0)	2.6 (1)	1.1 (1)
Ceramics and structures	0 (0)	5.3 (2)	9.1 (8)
Ceramics, lithics and structures	0 (0)	2.6 (1)	1.1 (1)
Ceramics, structure and human bone	0 (0)	0 (0)	1.1 (1)
Lithics	3.8 (1)	10.5 (4)	6.8 (6)
Structures	0 (0)	13.2 (5)	11.4 (10)
Total	**100 (26)**	**100 (38)**	**100 (88)**

Table 2: Percentage frequency of spatial distribution of sites identified in the Katavani Kunta Valley by the reconnaissance surveys, the systematic transect survey and all known sites; actual frequency of sites is shown in brackets

Location in valley	**Reconnaissance Survey (%)**	**Transect Survey (%)**	**All Known Sites (%)**
NE facing slope - top	0 (0)	18.4 (7)	12.5 (11)
NE facing slope - middle	0 (0)	21.1 (8)	15.9 (14)
NE facing slope - base	65.4 (17)	15.8 (6)	28.4 (25)
SW facing slope - top	3.8 (1)	18.4 (7)	15.9 (14)
SW facing slope - middle	0 (0)	7.9 (3)	10.2 (9)
SW facing slope - base	15.4 (4)	18.4 (7)	12.5 (11)
Valley Floor	7.7 (2)	0 (0)	2.3 (2)
Plateau	7.7 (2)	0 (0)	2.3 (2)
Total	100 (26)	100 (38)	100 (88)

between transects during the course of the systematic transect survey. Once more, these were found at a variety of locations on the valley slopes and contain a range of archaeological phenomena. Two sites that were located during the reconnaissance surveys were revisited and additional categories of material culture including human skeletal material were recorded at these sites.

The sites identified between transects cannot be analysed in the same manner as those discovered by the systematic transect survey, as they do not comprise part of a systematically derived sample. However, they do provide a larger sample of the archaeological record of the Katavani Kunta Valley. In total, 88 sites containing archaeological materials have been identified in the Katavani Kunta Valley, through both types of survey (Tables 1-2; Fig. 9). It is against this combined data set that the two survey methodologies will be contrasted in order to assess their effectiveness in accurately characterising archaeological landscapes. Two sites that were located during the reconnaissance surveys were revisited and additional categories of material culture, including human skeletal material in one instance, were recorded at these sites.

Comparison of survey models

Systematic transect survey techniques have provided a broader picture of the archaeological and rock art landscape of the Katavani Kunta Valley than was previously possible with the reconnaissance surveys. However, it is clear that a number of sites that were identified by the reconnaissance survey were not located by the systematic survey. In particular, the religious rock art imagery identified at half of the sites located by the reconnaissance survey was only seen at three sites during the systematic transect survey. In order to further assess the utility of systematic survey methods, models of spatial distribution and site composition derived from the two sets of survey data will be compared against the larger data set of all known sites in the Katavani Kunta Valley. By comparing the three data sets as percentages of all sites within each individual data set it is possible to identify which survey method provides the most accurate model for site composition and the overall distribution of sites (Tables 1-2; Figs. 10-11).

A comparison of the systematic transect model and the reconnaissance model for both the archaeological composition of sites and the spatial distribution of sites against all known sites in the Katavani Kunta Valley indicates that the results of the systematic transect survey provide a more accurate model from which to characterise this archaeological landscape. Although some discrepancies occur in the model derived from the systematic transect survey, these appear to be the result of the influence the reconnaissance survey on the total data set, which focused on the valley floor and the identification of rock art sites.

Discussion

The systematic transect survey of the Katavani Kunta Valley has expanded upon previous surveys by revealing a more archaeologically complex and spatially varied rock art landscape. The key findings of this survey have been that (a) rock art sites are more broadly distributed across the landscape than had previously been known, which have allowed for distinct patterns of land use to be recognised, and (b) that there are numerous surface archaeological deposits throughout the valley, some being associated with rock art and thus providing a new line of evidence for the chronology of rock art production in this area.

The results of systematic transect survey show that rock art sites are found at a number of different locations throughout the Katavani Kunta Valley, but occur more commonly on the northeastern facing slopes, whereas the reconnaissance surveys suggested the valley floor was a focus for rock art activities. Recent white painted religious rock art imagery is focused at the base of the valley, whereas red painted and crayon drawn rock art, black painted rock art and white painted rock art images occur at a greater variety of locations. Further variation within this body of rock art has been identified through detail analysis of the imagery (Taçon *et al.*2010). Thus this study helps to highlight how people have variably integrated their physical landscape into their social lives during different periods.

The reconnaissance survey had indicated that surface archaeological deposits were present at some sites but provided few details for further analysis, whereas the systematic transect survey has identified many more sites of archaeological interest, as well as a broader range of archaeological materials. Beyond the range of lithic and ceramic artefacts identified and associated with known types from nearby assemblages, which have expanded upon those recorded by the reconnaissance survey, a number of stone structures were recorded in the transect survey. These bear some affinities to Megalithic burial structures, in one case associated with human skeletal remains, and are often associated with Iron Age ceramic types. The identification of these structures suggests that the Katavani Kunta Valley was part of a more varied symbolic landscape than was previously thought. The Late Neolithic to Late Iron Age is the most clearly represented period in the ceramic assemblages of the Katavani Kunta Valley, which may be an indicator of the age of some of the rock art imagery.

With the broader understanding of the surface archaeology of the Katavani Kunta Valley as

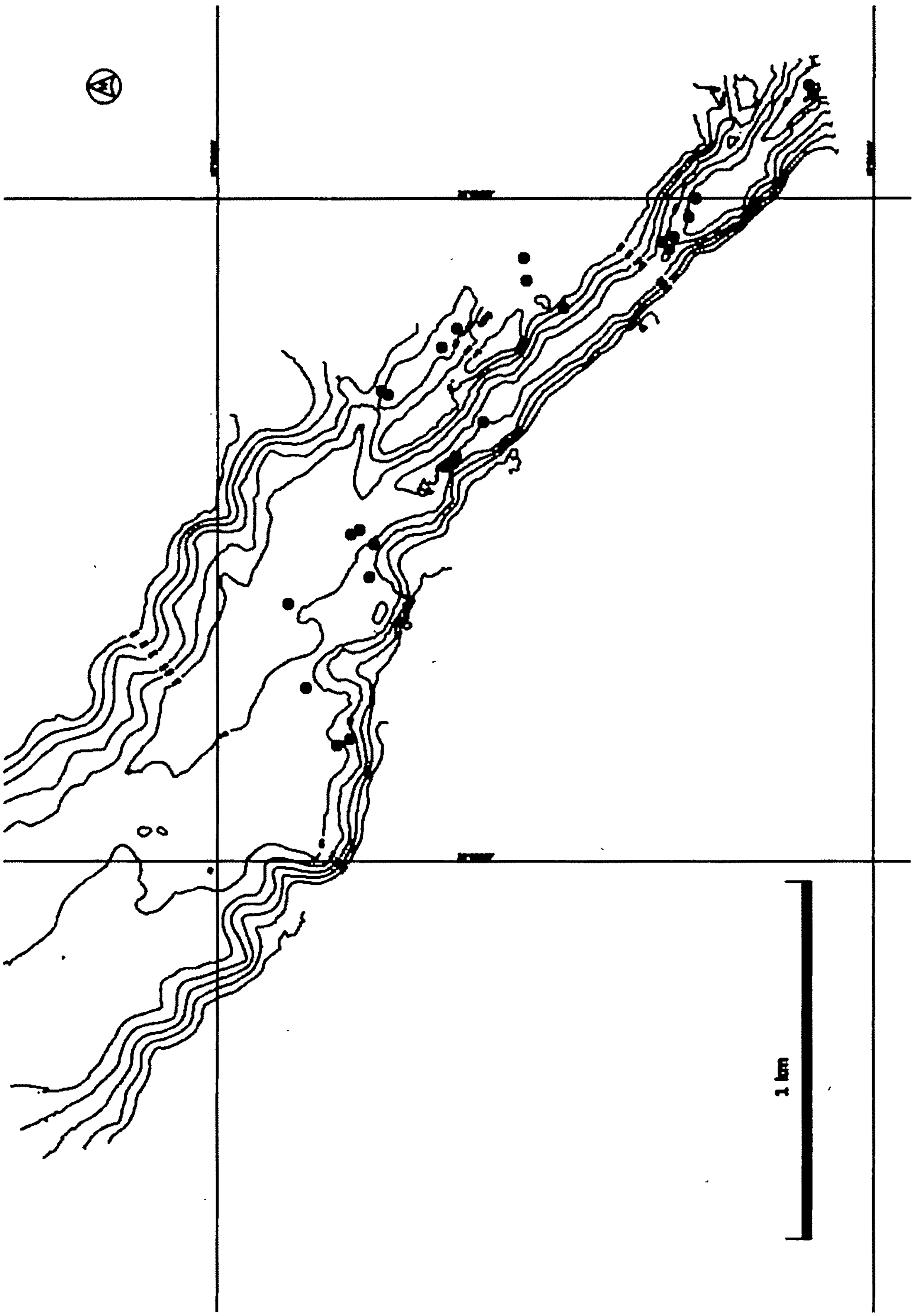

Fig. 7: Sites identified by roadside surveys in the Katavani Kunta Valley (from Blinkhorn 2008)

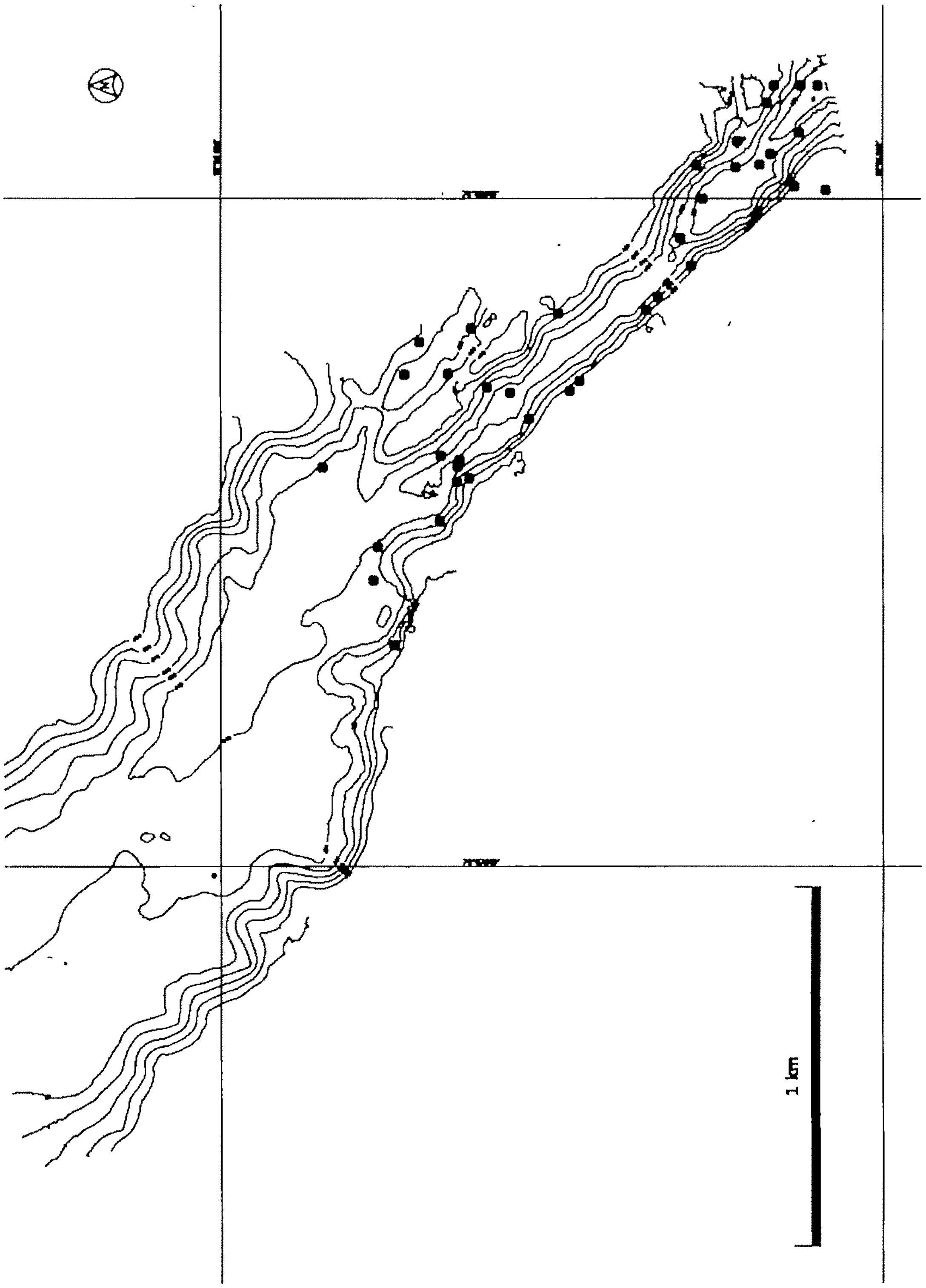

Fig. 8: Sites identified by systematic transect survey in the Katavani Kunta Valley (from Blinkhorn 2008)

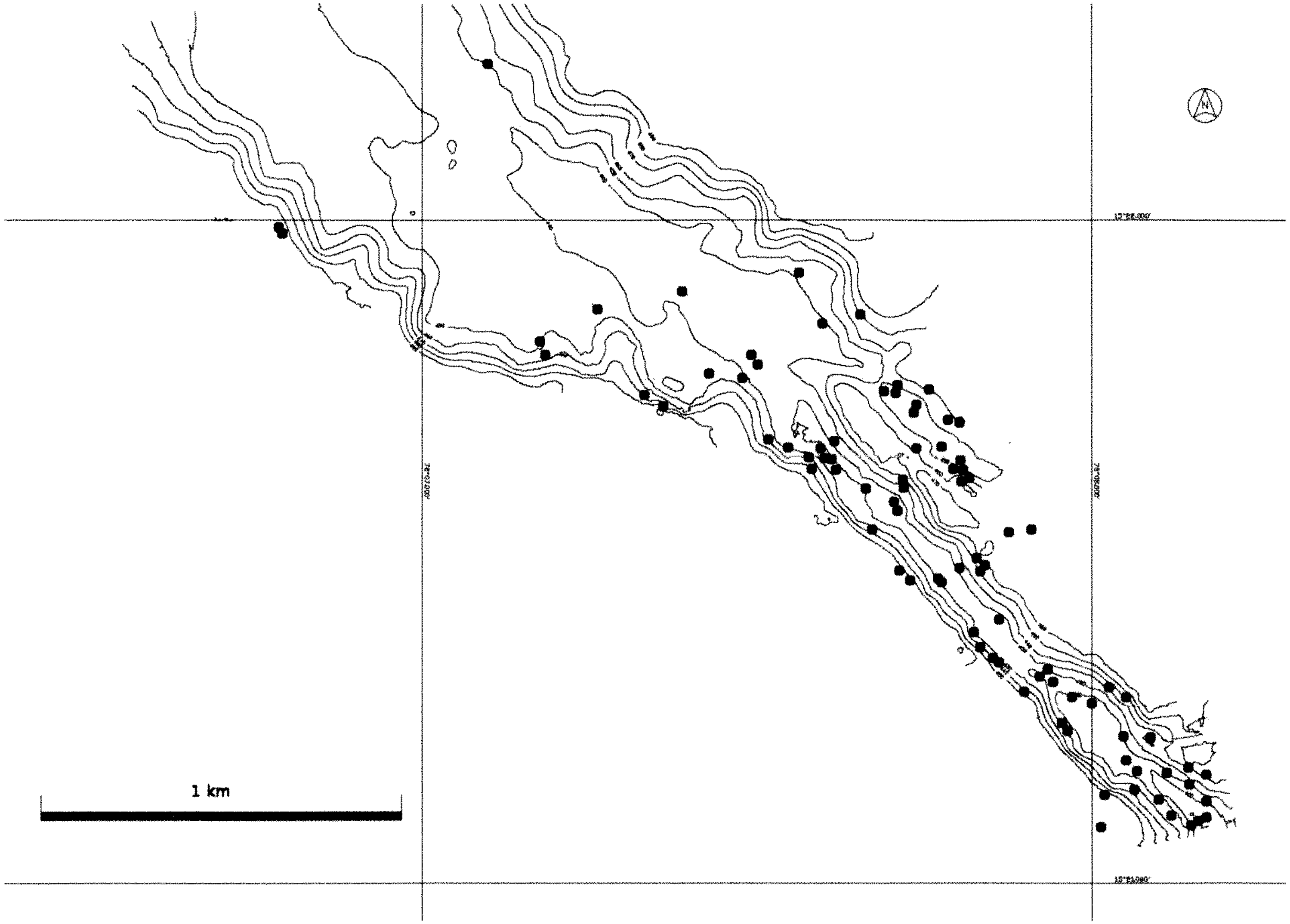

Fig. 9: Map of all known sites in the Katavani Kunta Valley (from Blinkhorn 2008)

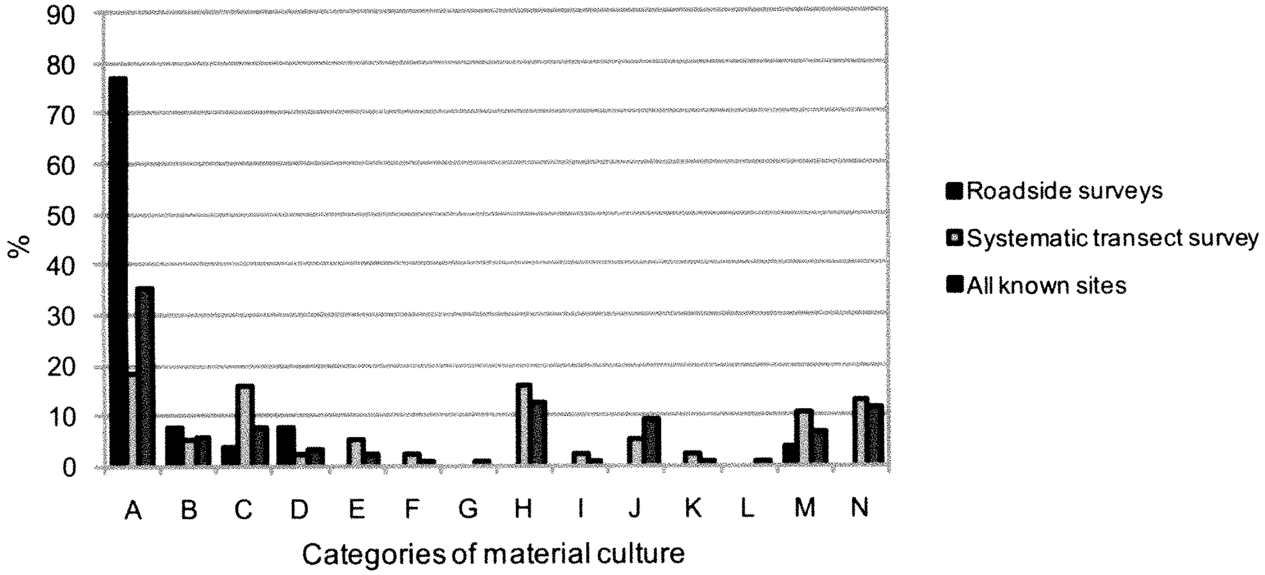

Fig. 10: Chart showing percentage frequency of archaeological site composition in the Katavani Kunta Valley identified by the roadside survey, systematic transect survey and all known sites (A – Rock art; B – Rock art and lithics; C – Rock art and ceramics; D – Rock art and structures; E – Rock art, ceramics and lithics; F – Rock art, ceramic and structure; G – Rock art, structure and lithics; H – Ceramics; I – Ceramics and lithics; J – Cermaics and structures; K – Cermaics, lithics and structures; L – Ceramics, structure and human bone; M – Lithics; N – Structures)

provided by the systematic transect survey, it is possible to consider the wider social context of both the rock art and archaeology of this area, beyond the valley itself. Investigations can begin to focus upon interactions between the inhabitants of the Katavani Kunta Valley, other nearby upland valleys and the floodplains of the Jurreru Valley. This point is particularly pertinent given the proximity of the valley to the Neolithic site of Pathapadu in the Jurreru Valley and the prominence of Neolithic and Megalithic ceramic types in the Katavani Kunta Valley

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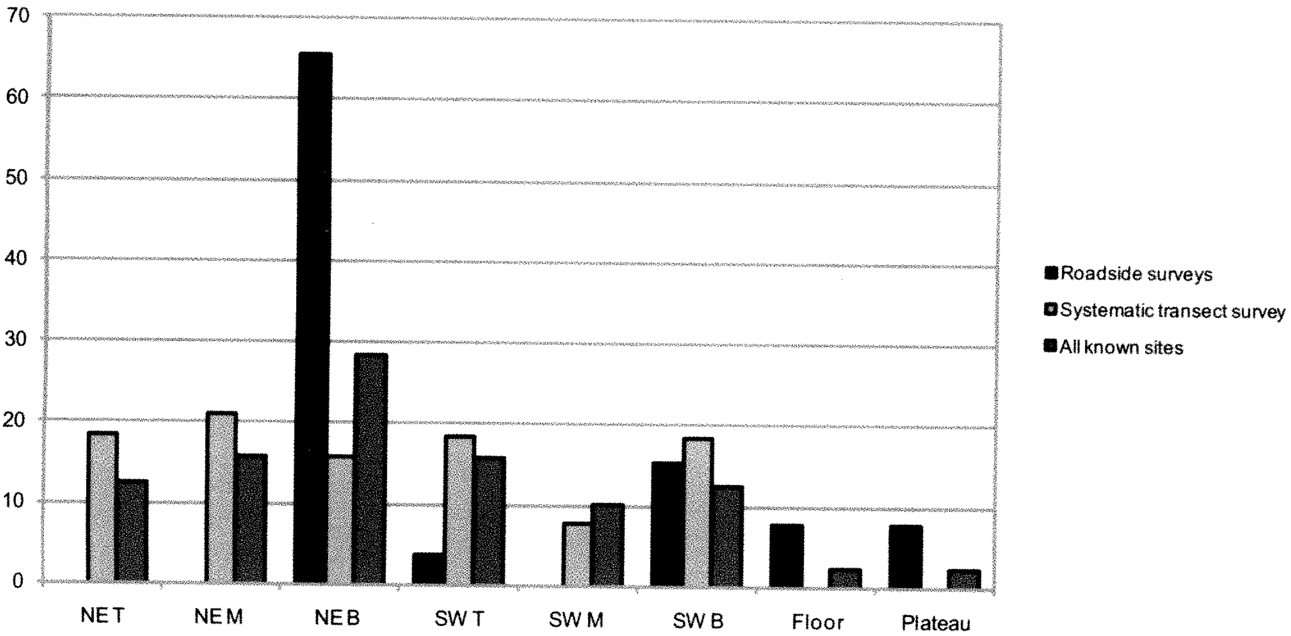

Fig. 11: Chart showing percentage frequency of the location of archaeological sites in the Katavani Kunta valley identified by the roadside survey, the systematic transect survey and all known sites (NE T = Top of Northeast facing slope; NE M= Middle of Northeast facing slope; NE B= Bottom of Northeast facing slope; SW T= Top of Southwest facing slope; SW M= Middle of Southwest facing slope; SW B= Bottom of Southwest facing slope)

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Reconstructing Operational Sequences: A New Methodology for the Study of Seal Carving in the Indus Civilization

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Abstract

This pilot study presents a new methodology for reconstructing the operational sequences carvers used to engrave stamp seals during the Indus civilization's urban period (2600-1900 B.C.). Drawing upon the anthropology of technology, this methodology shifts the object of study away from static morphological attributes to dynamic sequences of actions. Using experimental replication and microtopographic analysis, the operational sequences used to produce two Indus seals from Chanhu-daro are reconstructed. Significant contrasts are evident in the operational sequences used to produce each seal, suggesting diversity in the social logics that mediated the relationships between carvers and the social representations that underpinned the Indus civilization's administrative system.

Introduction

Indus stamp seals are the largest source of imagery and script from the Indus civilization's urban period (2600-1900 B.C.). They played a major role in demarking status, group membership, and other personal identities for their users (Fairservis 1976). They were also the primary component in a technological system that facilitated Indus administrative practices, allowing their users to create clay sealings on doors and containers (Frenez and Tosi 2005). Because of their role as administrative tools, identifying the technological choices made by carvers who created these administrative artifacts allows archaeologists to characterize the shared ideas and practices that underpinned Indus administration. To accomplish this, it is necessary to isolate and examine key operations in their production.

Drawing on the anthropology of technology, this pilot study utilizes experimental replication and microtopographic analysis to develop a new methodology for reconstructing the sequence of carving actions used to engrave Indus seals. This permits identification of the operational sequences used by Indus carvers to engrave motifs onto Indus stamp seals, providing insights into the social representations, or "sets of shared ideas by members of a given social group" (Lemonnier 1993: 49) that empowered Indus administration. This study presents some preliminary results from applying this new methodology to two stamp seals from Chanhu-daro. Utilizing experimental replication and microtopographic analysis, it is possible to reconstruct the operational sequence used to produce each seal. Contrasts in these operational sequences suggest that there were considerable differences in the social context of each technological performance.

Background

Steatite stamp seals are among the key artifacts that characterize Indus assemblages that belong to the urban period (Kenoyer 2003; Possehl 2002; Rissman 1989; Wright 2009). Typically they are small (2.5 x 2.5 cm) steatite objects that are cuboid in shape, with an intaglio engraving on the front and a rounded, perforated boss on the back (Marshall 2004). The unicorn motif, which is the most common image engraved on Indus seals, consists of a bovid in profile facing the upper left corner of the visual field along with a small stylized "standard" in front of the animal and a line of undeciphered text across the top (Fig. 1). Their role in creating clay impressions that sealed different kinds of containers, providing a method for authenticating economic transactions is well documented (Frenez and Tosi 2005; Rao 1985).

Previous scholars have examined stylistic variability in seal engravings by identifying different elements within motifs and coding their variants in order to conduct statistical analysis. Rissman (1989) examined stylistic variation in the heads, necks, withers, and standards from 601 seals recovered from

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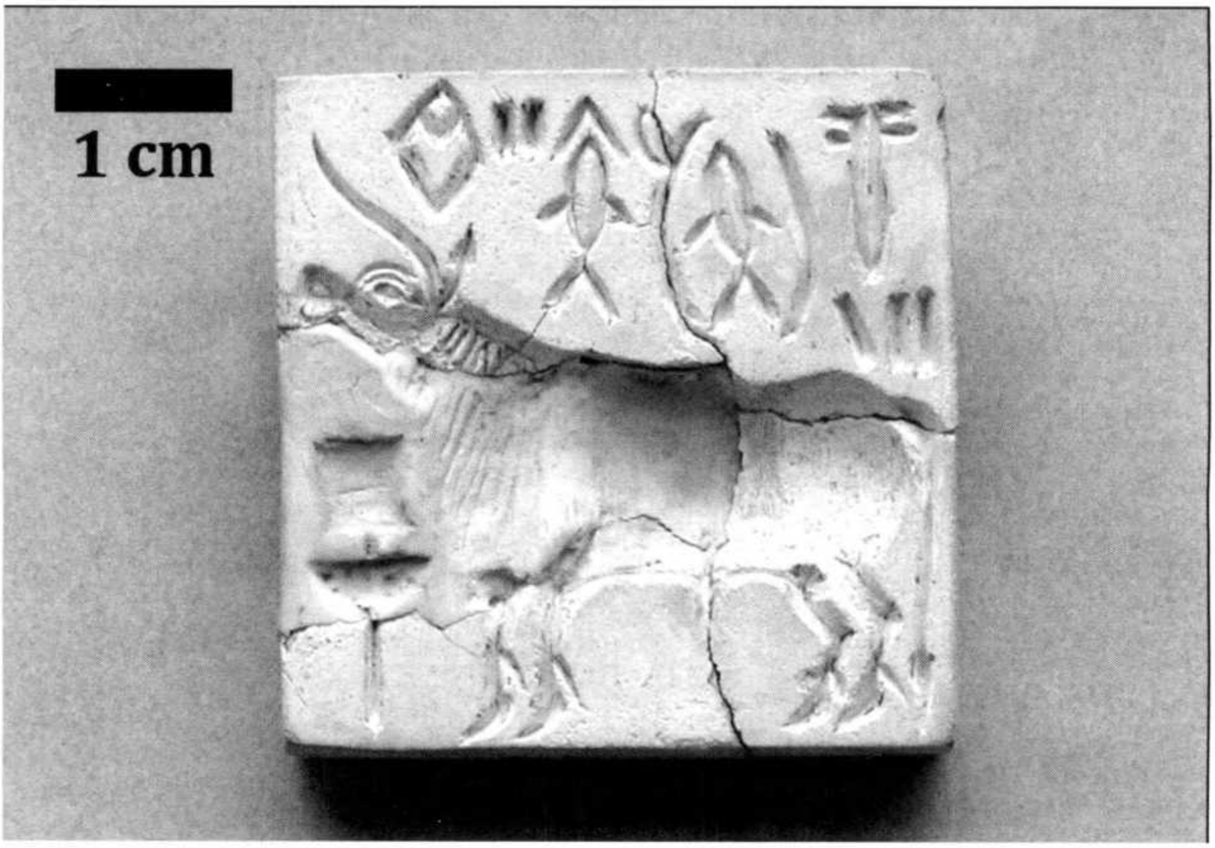

Fig. 1: Stamp Seal L-177 recovered from the site of Chanhu-daro.

several major Indus sites. He determined that there were up to four well-defined stylistic groups among the seals in his sample, arguing that they belonged to different schools of artisans. He also suggested that one of these "schools" was present at both Mohenjo-daro and Chanhu-daro. Franke-Vogt (1992) contested Rissman's results. Identifying far more variation in stylistic attributes than Rissman, she argued that seal production was probably highly localized. It is difficult to reconcile the two perspectives because each author noticed vastly different amounts of variation within the same set of stylistic attributes. Additionally, the relatively coarse temporal resolution of their samples (700 years) risks rendering static the dynamic social relationships that characterize social boundaries in any complex society (Hegmon 1998).

This pilot study takes a new approach to seal production by drawing upon the anthropology of technology to shift the object of study away from static stylistic traits to the dynamic sequences of action that were used to engrave seal imagery. Broadly speaking, the anthropology of technology is the study of human action and its results on the physical world (Lemonnier 1992). Operational sequences, which divide human action into technological stages, are a useful source of basic data for analyzing technological performances. Once actions have been organized into stages, it becomes possible to identify "social choices," or decisions within a technological operation that are not constrained by the physical requirements of the task at hand (Lemonnier 1993). The word "choice" is used loosely here; agents make social choices based on deeply embedded cultural values that may or may not be subject to change. These choices are the result of technological practices that have been built up through social practices (Wright 2002), and may or may not be subject to change by individual agents.

Reconstructing the operational sequences, or the *chaînes opératoires,* that make up technological systems allows archaeologists to identify the flow between culture and physical action. It has been applied to archaeological problems in many different ways, sometimes becoming perilously similar to the typological systems it sought to replace (Bar-Yosef and Van Peer 2009) or devolving into an overly linear graphical representation of a production process (Vidale *et al.* 1992). This study draws upon the concept of *chaînes opératoire* as articulated by White (1996) and Inizan (Inizan *et al.* 1999). The major components of this approach are:- (1) the operational sequence used to produce an object yield insights into the social and cultural contexts of its creation and use and (2) operational sequences are the result of the interplay between sequences of action and conceptual schemes that guide them. A sequence of actions is a concrete set of reconstructed physical movements [Inizan's (Inizan *et al.* 1999) operative scheme]. Conceptual schemes are entirely mental, sometimes subconscious plans that guide that action. They are apparent in the social choices carvers make when performing a sequence of actions. This firmly grounds them in the social and cultural contexts of a technological performance.

The analysis of conceptual schemes is highly subject to scale. When sequences of action can only be reconstructed by examining a large sample of artifacts, the resulting conceptual scheme reflects something shared by all of the agents that produced the sample. Some technologies, such as steatite carving, produce very fine-grained material traces of the sequences of action used in their performance. This results in an ideal situation for technological analysis; the conceptual scheme guiding the operational sequence for *each object* is at least partially reconstructable. While interpreting the meaning of shared and contrasting operational sequences still requires a careful consideration of the way conceptual schemes are shared and pass down within a society (Bar-Yosef and Van Peer 2009), the relationship between conceptual scheme and technological performance is unambiguous.

Significant patterns underlay the social choices made by agents in past societies. Lechtman (1977) called these patterns technological styles, which are complex articulations between technological practices and cultural beliefs. Subsequent scholars have argued that patterns in technological choices are tied to social representations that were profoundly meaningful to the people who make them (Lemonnier 1993). These social representations are revealed in the selection of certain raw materials and technological practices and the rejection of others by people in the past (White 1996; White 2007). Studying the social representations that underlay past technological performances reveals characteristics of past societies that are invisible in more conventional morpho-typological studies. The talc-faience production complex (Miller 2007; Vidale 2000) is a good example of a meaningful social representation underlying many Indus technologies, as is the preferred use of steatite from dolomitic sources at Harappa even though non-dolomitic steatite may have been more readily accessible (Law 2008).

To access social representations that were important to Indus carvers, it is necessary to reconstruct key stages in the operational sequences used to produce Indus seals. It is often impossible to analyze entire technological systems (or even an entire operational sequence) in living societies (Lemonnier 1992). As a result this study aims to "sample" a point in the production process that would have been particularly critical to the finished seal. As mentioned previously, stamp seals probably had multiple uses, both as emblems that demarcated social boundaries within Indus society (Fairservis 1976; Kenoyer 1998; Kenoyer 2000; Kenoyer and Meadow 1996) and as administrative tools used to transfer a reverse image of the seal's engraving to a clay sealing (Frenez and Tosi 2005; Rao 1985). Given that they were also perforated for suspension, they were probably used as personal ornaments (Kenoyer 2000; Mackay 2004). In all of these contexts, the seal's image and inscription would have been central to its use. For this reason, this study focuses on reconstructing the sequences of physical action used to engrave the image and inscription into the seal's surface. While each step of a seal's production was undoubtedly laden with important social choices, the apparent importance of a seal's visual properties makes the detailed reconstruction of the operational sequences used to engrave seal imagery a fruitful starting point for analysis.

The goal of this study is to identify fine-grained, individualized carving sequences based on the microtopographic features of seal engravings. Previous scholars have demonstrated that it is possible to identify different *kinds* of actions used to produce carved stone seals in other cultural contexts. (Sax and Meeks 1995; Sax *et al.* 1998). While this kind of research reveals qualitative differences in the tools and techniques used in a technological system, it does not identify the precise sequences of action used to produce an object. The methodology presented here is primarily concerned with differences in the sequences of similar actions used to produce a finished object and the conceptual schemes that underlay them. To that end, this preliminary study identifies the sequences of actions taken by a single or small number of carvers using the same *kinds* of action, or techniques, in this case back-and-forth burin strokes and scraping on a flat steatite surface.

To reconstruct the order of these carving actions, it is necessary to review the techniques other scholars have already tied to seal carving. Indus sites have produced a vast assemblage of seals with different engravings, unfinished seals, and a large assortment of copper tools that could have been used in seal production. It has been demonstrated that Indus carvers began by acquiring dolomitic steatite from a complex long-distance trade network (Law 2008). After cutting raw steatite into cuboid blanks with perforated bosses using saws made of arsenic copper, Indus carvers created their engravings using a variety of thin copper chisels or burins (Mackay 1976; Mackay 2004; Vidale 2000). Different carving sequences were used to produce different motifs, and it appears that some carvers knew the motif they intended to produce so well that it did not matter which particular element they carved first (Mackay 2004). It is possible that some carvers used a measurement system or grid to plan their motifs, but this point requires further investigation (Fairservis 1976; Mackay 2004). Given the presence of seals lacking either the animal motif or inscription, it is also possible that a number of carvers worked on the same object, with some artisans specializing in inscriptions and others in carving the animal motif (Vidale 2000). After the carvings were complete, seals appear to have been heated to temperatures exceeding 1000 °C in order to whiten their surfaces (Kenoyer 1998; Vidale 2000). Some kind of alkaline soak may have been applied before heating to enhance the whitening effect, but the techniques involved in this step of the production process are still unknown (Kenoyer 1998; Law 2008).

Experimental Replication

The primary component of this study's methodology was the experimental replication of Indus seals by a number of individuals. Experimental replication involves replicating artefacts using tools and techniques that would have been available to past artisans (White 1995; White 1996). In order to increase the plausibility of results, replication must be informed by specific archaeological contexts as much as possible. This means that replicated artefacts should be based on specific archaeological referents, using the same kinds of raw materials and tools that would have been available in the past, thereby increasing the likelihood that the actions used by the experimenter to produce replicas will be similar to those used by past artisans. It also raises the probability that the material traces left on replicated objects will be similar to those that can be identified on archaeological referents, allowing archaeologists to infer past actions.

To increase the sample of carving actions considered by this study, a number of individuals participated in the replication project. Four participants in addition to the author were familiarized with the production procedure described above. While all participants used the same suite of tools and techniques, each brought his or her particular skills and habits to the replication process. By examining the replicas produced by more than one individual, the study controls for idiosyncratic production behaviours and allows the identification of more generalized microtopographic production traces.

An assemblage of Indus artifacts recovered from Chanhu-daro was sampled for archaeological referents. Chanhu-daro is an Indus site located approximately 140 kilometres from the major urban center of Mohenjo-daro. It is widely believed to be a craft production site, due to the presence of a complex pyrotechnical installation and a large proportion of unfinished seals and beads in its assemblage (Mackay 1976; Possehl 2002; Vidale 2000). Because unfinished seals were recovered from the site, there is a high likelihood that the tools commonly used in seal production are present within its assemblage. Furthermore the site's small size provides a constrained and manageable sample for an intensive examination of individual objects.

As at other Indus sites, Chanhu-daro's seals are made of steatite, a rock composed of talc that comes from the margins of the Indus River's alluvial plains (Law 2008). It is soft (Mohs Hardness = 1), easily carved, and changes colour when exposed to high temperatures. Replicate seals were produced using green steatite from an Italian source that possesses similar physical properties. It is sold in cube or cuboid blocks marked with abrasion lines produced by a modern circular saw. It possesses the same hardness as the steatite used by Indus carvers, and becomes white or bright pink when fired at temperatures exceeding 1000 °C. Before analysis, three of the replicated seals were fired, and the rest were left unfired. Firing does not appear to have affected the microtopography of the engravings.

Four of the copper tool types believed to have been involved in seal production were created for the replication project (Fig. 2) (Mackay 1976). These included scrapers, burins, saws, and knives that were recovered from various locations in the urban levels of the site (Mackay 1976). Tools from the archaeological assemblage were reproduced using modern sheers and hammers to create objects of approximately the same size and shape. To keep working edges fresh, the tools were continually sharpened with a steel file or hammered to increase their resilience.

Tools with a variety of working edges were used to replicate seal engravings. Scrapers (Fig. 2; B-C) are characterized by long, flattened, blade-like edges at the tip of a rod with a rectangular cross section. These are based on the objects labelled "chisels" in the original excavation report (Mackay 1976). These were used to hollow out features with high relief, create smooth surfaces with few if any production traces, and create linear features with slight curves. Burins (Fig. 2; A-B) have pointed, diamond or square-shaped working edges. Some of these were placed in ovoid wooden hafts that allowed experimenters to leverage pressure downward, quickly producing deeply engraved linear features similar to those produced using scrapers. While burins could produce linear features that are more irregular than those produced using scrapers, there is considerable overlap in the kinds of marks that could be made with the two tool types. Saws and knives were also used in the replication project. They possessed long, flat, working edges that were most often used by experimenters to produce seal blanks, though they sometimes were used in the engraving process to quickly smooth or abrade a surface in preparation for carving.

Metals of the same composition as the tools from Chanhu-daro were not available. Modern alloys with similar properties as their archaeological referents were used as a substitute. Natural copper rods (99% copper) were used to produce a small burin, small scraper, medium scraper, saw, and two small knives. While the natural bronze tools were hard enough to carve steatite (>1 on the Mohs scale), their points had a tendency to crumble during use. Bronze rods (~85% copper) were therefore used to produce most of the tools used for replication, including five burins, five small scrapers, and a round saw approximately 3 mm in thickness. These tools were harder than those made of copper, though their specific hardness varied based on how much they had been forged or filed during use.

Two recording techniques were used during the replication process. Each project participant kept a detailed logbook while carving. Logbooks recorded the carving tasks participants attempted to complete, the duration of each task, the tool used for each task, the way the tool was used, and participants' impressions from working with the stone. In addition to the logbook, time-lapse photo archives were created to document the carving process for three of the experimental seals. A digital camera was positioned above the carvers' left shoulder, with the front of the seal on which he or she was working in view. Pictures were taken every minute throughout the carving process, documenting the replicated seal's level of completion. These time-lapse photos provided a convenient record of the sequence of actions taken to complete the experimental seals. They also provided a record that was independent of what each project participant *thought* they were doing, illustrating the actions they took throughout the carving process.

Using the time-lapse archives in conjunction with the logbooks, it was possible to examine the exact sequence of actions used by each project participant to create his or her replicated seal. In this way, the project produced a collection of replicated seals with known operational sequences. It was thereby possible to link the microtopographic features of a replicated seal to the operational sequence used to produce it.

Microtopographic analysis involves examining the microscopic relief that characterizes features on an object's surface. The microscopic features of an engraving's surface are directly shaped by the specific habits of individual artisans (Kenoyer 1998). Therefore examining the microtopography of a surface can help archaeologists characterize the shape of specific cut marks or the directionality of the cutting actions used to produce them (Bello *et al.* 2009). This study utilizes the Edge H-160 3-Dimensional Real Time microscope coupled with the Syncroscopy's AutoMontage software package to establish the link between the microtopographic features of the replicated seal engravings and the carving sequences used to produce them.

The Edge H-160 3-Dimensional Real Time microscope is an optical system that uses a special head to combine light wavelets from multiple viewing angles. Unlike standard optical stereomicroscopes, the H-160 produces sharper, high-resolutions image in the ocular lenses that preserve in-focus three-dimensional information from the surface of the object on the platform (Greenberg and Boyde 1997). This image can be viewed and in real time; adjusting the platform allows the microscope user to pan across the surface of an object quickly, gaining an overall impression of its microtopography before capturing a digital image of the view field. A stationary H-160 was used to examine replicated seals and a portable prototype under development at New York University's Department of Biomaterials that uses the same optical system was used to examine the seals from Chanhu-daro. 5x objective lenses were used with both microscope systems.

Images were captured using AutoMontage software from Syncroscopy's digital imaging software package. Once regions of the engraving with informative concentrations of microtopographic features were identified, the microscope was switched to an image capture mode that uses an attached digital camera. Between twenty and thirty images were taken so that in-focus information for the entire viewing field was acquired. These images were then combined in AutoMontage. AutoMontage uses parallax to reconstruct the depth gradients present within a set of images. This results in two kinds of images. Stereopairs present two distinct images of the same viewing field that can be combined by properly positioning ones' eyes or using a stereoscope (Fig. 3). False color gradients are another kind of image that presents the depth within a particular image as a gradient between of different colours, in this case from blue to yellow to red as the height of the surface increases (Fig. 3). These images illustrate the microtopographic relationships between microscopic

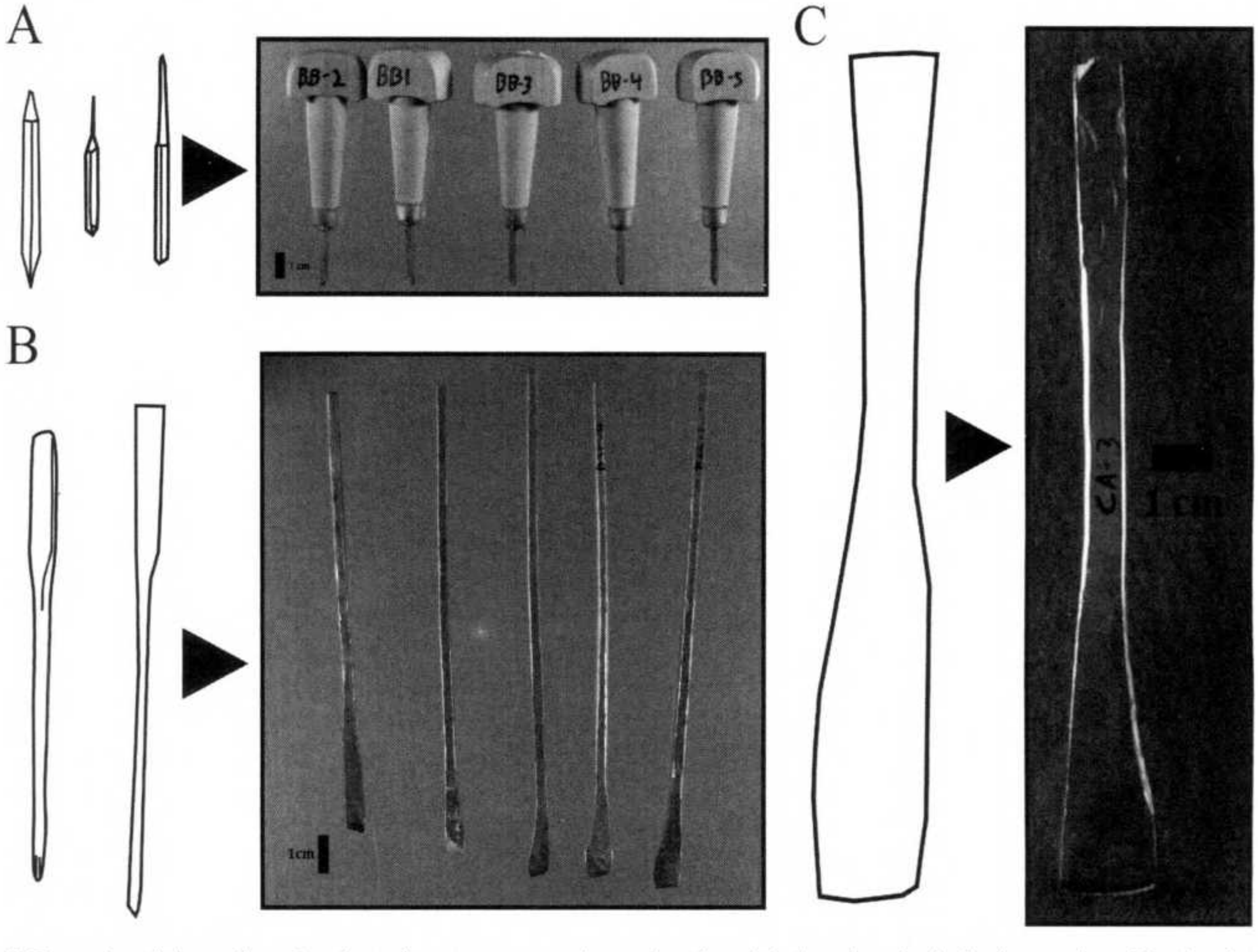

Fig. 2: Examples of the replicated tools used to engrave experimental seals and their archaeological referents from Chanhu-daro

features more clearly, but lack the colour and texture that is sometimes necessary to identifying the precise relationship between microtopographic features.

While the images produced using this system may be more difficult to interpret than those produced using a Scanning Electron Microscope, using the H-160 has a number of advantages. Optical microscopy is non-destructive, which means it can be used to examine the actual artefacts instead of silicone moulds or casts. It is portable, which means that it can be used on objects that have been curated in museums and cannot be moved for scientific analysis. Finally, producing digital images is not costly, and dozens of images can be taken in one or two hours. This allows for a more holistic consideration of an object's surface, and microtopographic patterns that could not be captured within a viewing field can be tracked through a series of images.

In total, five replicated seals produced by three of the project participants were examined using the stationary microscope. Two seals from the Chanhu-daro assemblage were also examined using the portable version to compare the experimental findings with the microtopography of objects from the archaeological record.

Eight seals were replicated during the experimental phase of this study. Five of the seals (Fig. 4) were produced by a single carver (C1), providing examples of objects produced at different stages in the learning process. The other three replicated seals were produced by different carvers (C2, C4, and C5) with varying levels of artistic experience (Fig. 5). While these carvers had only produced one replicated seal at the time of this study, the replication project is ongoing, and the preliminary results presented here will be tested in upcoming studies as the data set becomes more robust.

While steatite is soft and easy to carve, the engravings that participants attempted to replicate are quite small and detailed. The replicated seals presented in this study represent the beginning of a learning curve, as each carver developed familiarity with the tools, techniques, and materials involved in seal carving. A clear progression is evident in the seals carved by C1 (Fig. 4), as he became more comfortable with the tools and techniques. While producing Experimental Seal 1 (ES1) and ES2, the carver had not yet learned to produce intaglio animal faces, giving the motifs an inside-out appearance. While these seals do not closely resemble their archaeological referents, they do have much in common with some of the unfinished or novice examples recovered from Chanhu-daro (Mackay 1976). It should be noted that not all of the project participants had difficulty learning to make an intaglio engraving. C2, who was an experienced sculptor before joining the project, replicated a seal that closely resembles its archaeological referent on his first try (ES5, Fig. 5). As C1 became more familiar with the carving process, his replicated motifs increasingly resembled their archaeological referents (ES3 and ES8).

While the carving sequence used to produce each of the experimental seals has been examined, the carving sequence used by C1 (Fig. 6) will be presented in the most detail. Analysis of the time-lapse photos from two of the replicated seals (ES2 and ES3) produced by C1 reveals that the same sequence of actions was used to produce both objects. Logbook entries suggest that this sequence was also used to produce the other three seals replicated by the carver. Microtopographic analysis, which will be discussed later, revealed that the sequence of actions used to produce all five of C1's replicated seals was remarkably consistent, even though the accuracy of each stroke improved with each subsequent seal.

The sequence actions C1 used to carve seals were strongly influenced by directionality. The carver always began by hollowing out the animal using back-and-forth burin strokes followed by scooping or back-and-forth scraper strokes, starting with its head in the top-left of the carving field and ending with its rear hoof in the bottom right of the carving field. This arbitrary technological choice, independent of the material constraints, represents the first stage of a conceptual scheme that C1 brought to the technological performance. These actions could be considered part of a discrete carving phase within a conceptual scheme, or collection of actions used to produce a particular element of the engraving at a particular point in the operational sequence. Breaks between these phases can be empirically identified because actions end toward the bottom right of the carving field, and start over with a new element of the engraving. The new element is also carved from the top-left toward the bottom-right. These directional "resets" can be used to identify discrete carving phases that constitute an overall carving sequence,

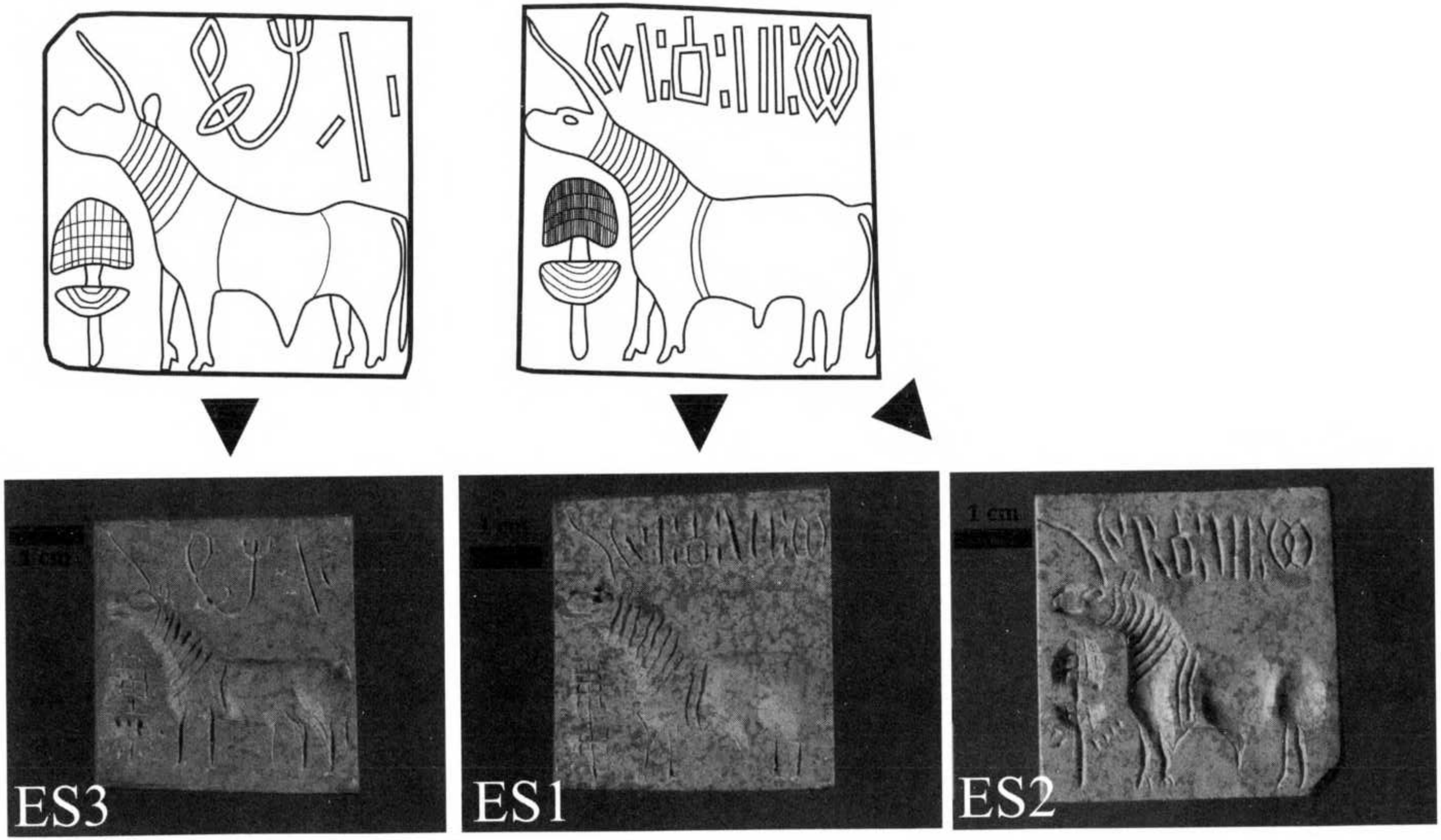

Fig. 4: Exprimental seals 1, 2 and 3 with archaeological referant. Redrawn from Mackay (1948)

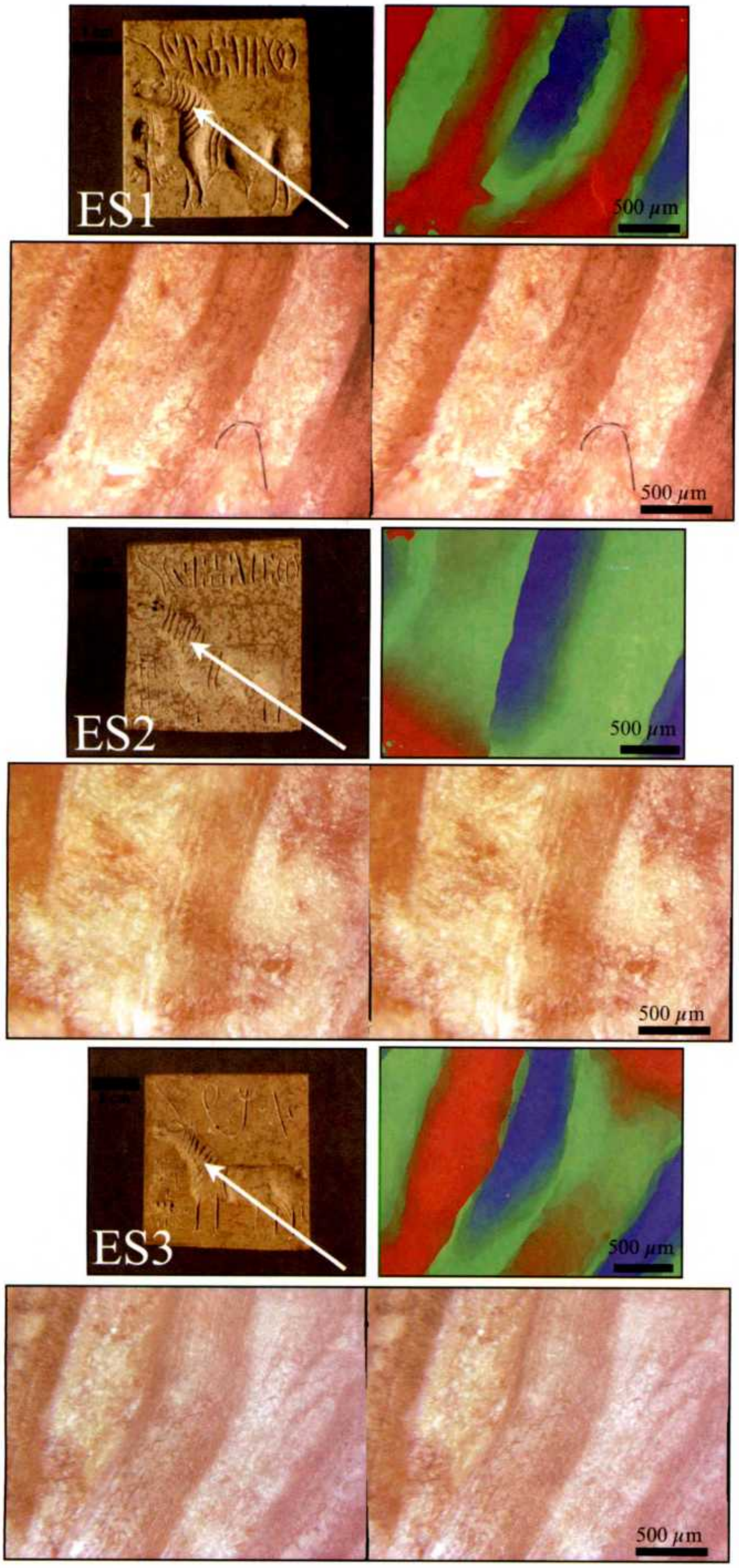

Fig. 3: Initial 3 experimental seals replicated by Carver 1 (the author). Quality of replication improves as the author becomes more comfortable with the tools and techniques.

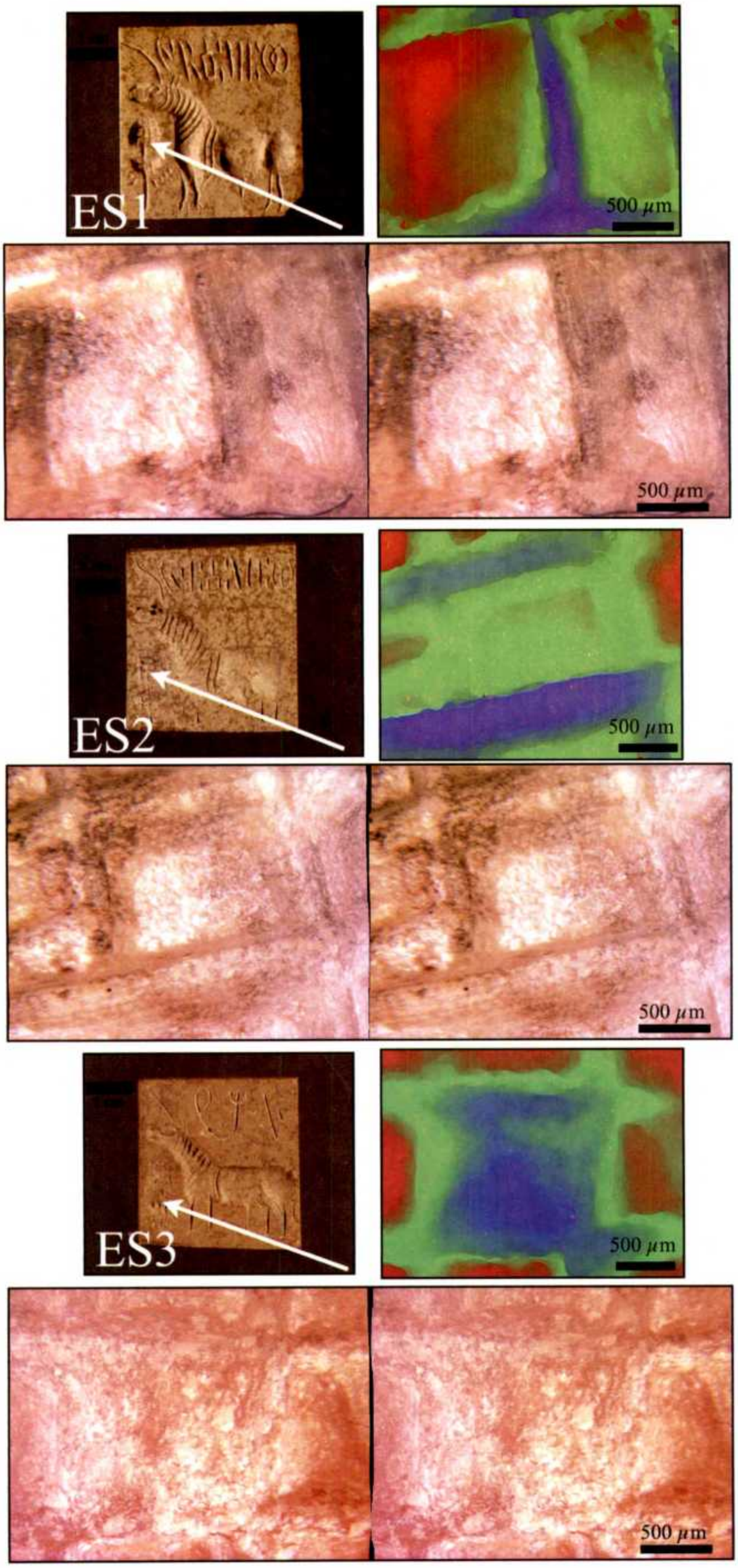

Fig. 7: Stereopair and color relief images of the standard details on three experimental seals. These images illustrate a clear progression of cuts from left to right, followed by overlapping cuts that run from top to bottom. This corresponds with the sequence identified in the time-lapse analysis.

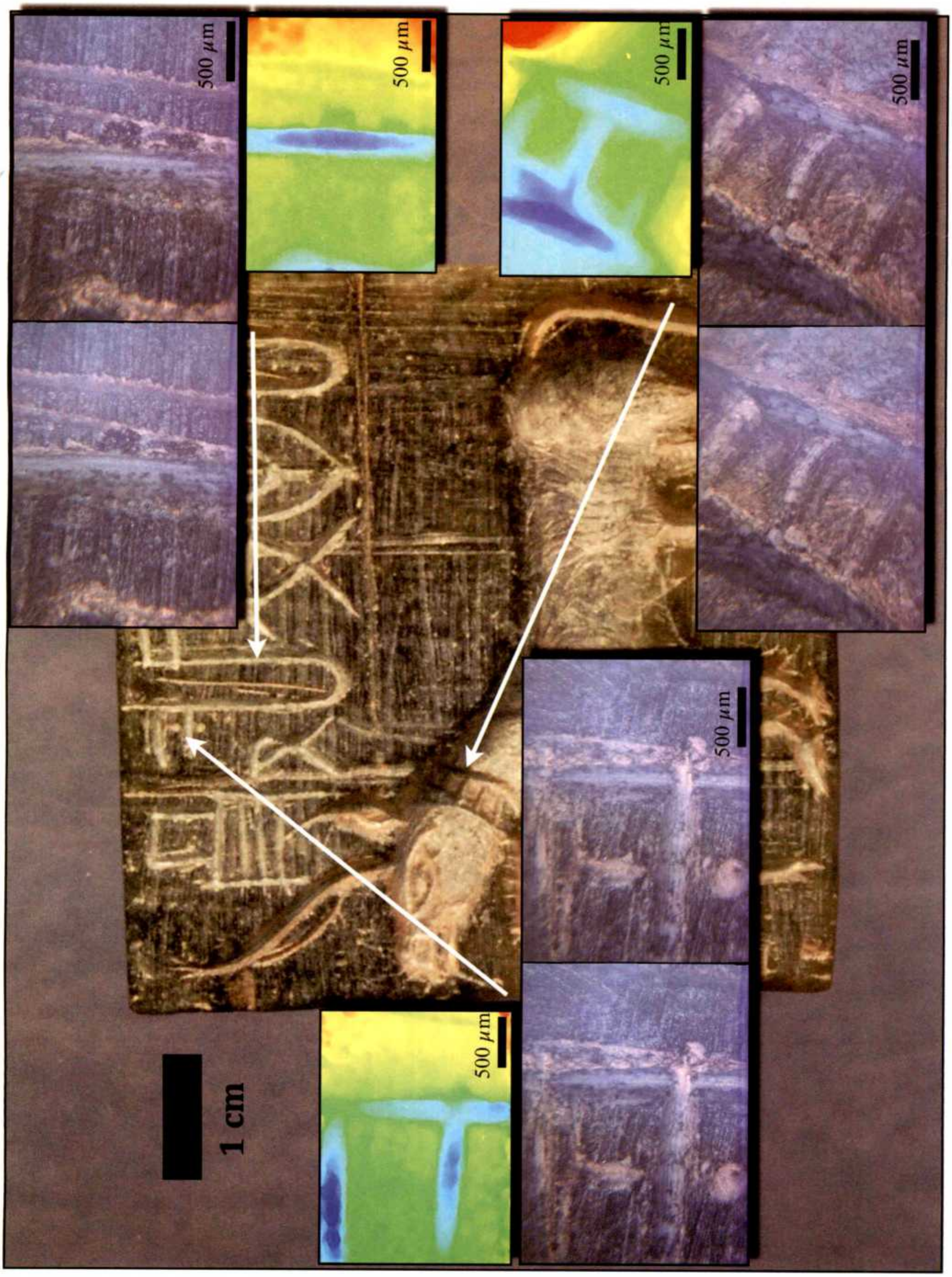

Fig. 8: Microtopographic Images of ES5. These images illustrate the importance of using depth gradients and overlapping cuts to reconstruct sequence. Note that in the top left detail for the second sign, it would be determine that the sign's details were carved after the body of the sign without examining overlap in the stereopair images.

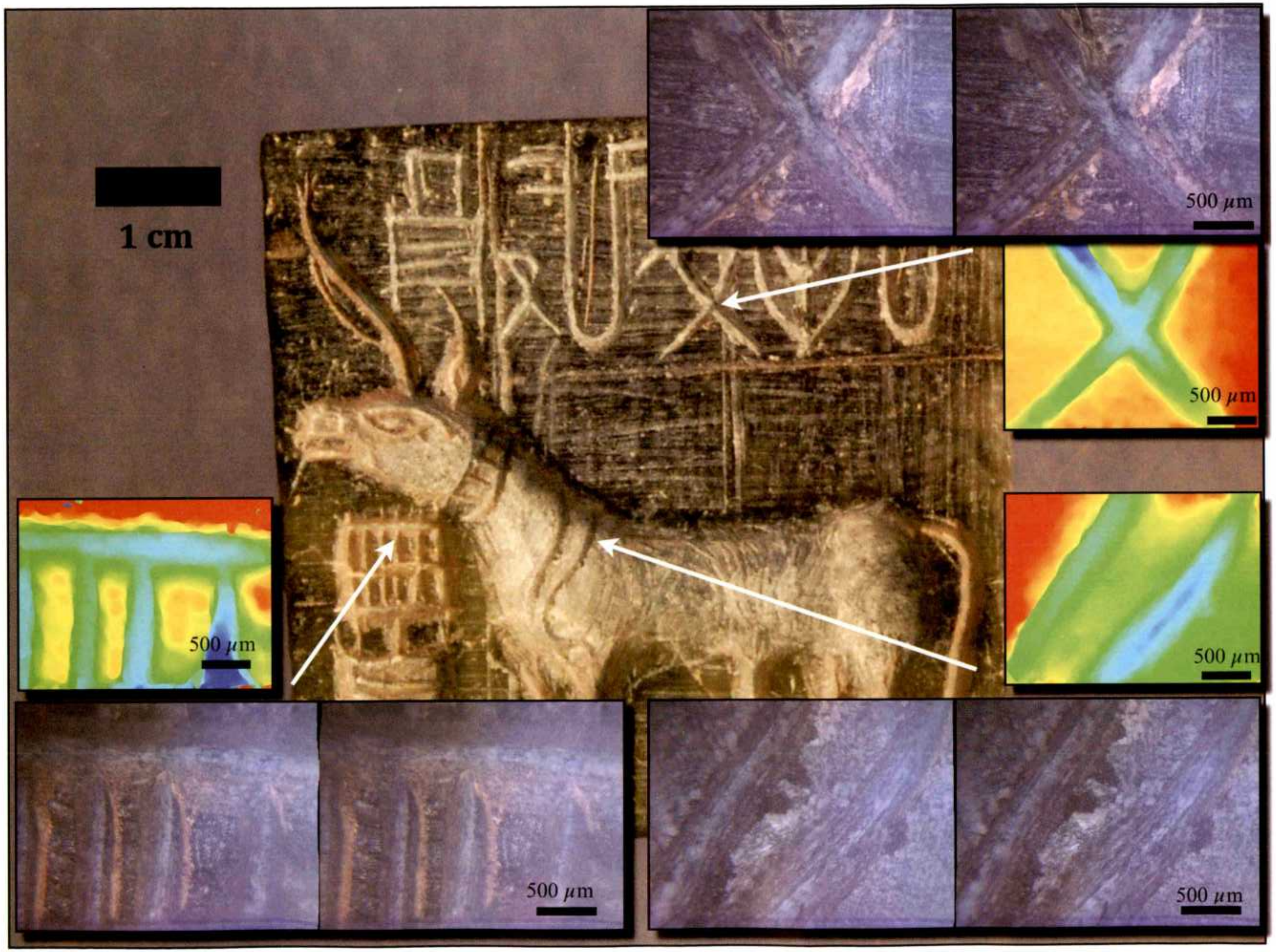

Fig. 9: Microtopographic Images of ES5. When the entire surface of ES5 is sampled, many features that allow the reconstruction of the seal's operational sequence are evident. Most useful is the fish sign, which has overlapping depth gradients that allow the reconstruction of the carving actions used to inscribe it is more orderly, with a clear progression from one feature to the next, while L-177's operational sequence is more fluid and complex.

and share much in common with platform preparation reorientations that can sometimes be used to identify lithic production stages in refit projects (Schlanger 1996). This addresses the risk that a reconstructed operational sequence exists only in the mind of the analyst (Bar-Yosef and Van Peer 2009).

The logbook reveals that C1 was unaware of this operational sequence while carving ES2 and ES3. It could not have been dictated by the physical constraints imposed by the raw material, and it is unlikely that handedness played a role in the organization of the carving sequence because the time-lapse photos reveal that the carver constantly rotated the seal while carving. No matter how the seal was positioned relative to the carver, carving phases began at the top-left and ended in the bottom right of the finished carving field. Starting at the top-left and finishing in the bottom right of an imagined complete engraving was an unconscious technological choice influencing the conceptual scheme C1 imposed on the technological performance.

Directionality also exerted a strong influence on the other project participants. Examination of C4's time-lapse archive reveals that she also tended to organize her production phases beginning in the top-left to the bottom-right of her replicated seals' carving field. While C2's actions tended to be more flexible than the other carvers', the same directionality structured the conceptual schemes he applied to his technological performances as well as well.

Microtopographic Analysis

The directionality that exerted a strong influence on replicated operational sequences left clear material traces in the microtopography of the replicated seals' engravings. Three features of the microtopography appear to be directly linked to the order in which specific cuts or features were carved.

(1) Overlapping cuts almost always reflect a sequential relationship between carving actions (most often burin or scraper strokes). The action that produced a deeper cut comes before the stroke that produced an overlapping shallow cut.

(2) The depth gradients along the floor of a cut often reflect the direction of the stroke that produced it. In all of the replicated engravings, cuts that were produced by strokes moving from left to right were shallower toward the left side of the cut and deeper toward the right. It seems that there is a general tendency for carvers to begin strokes by applying light force until they are sure of the stroke's trajectory, and increase force toward the end of a stroke, producing a depth gradient in the floor of a cut.

(3) Features carved early in a sequence of actions are often shallower than features carved later. This is due to the reductive nature of carving; each action results in the cumulative removal of stone from the seal's surface, resulting in an overall decrease in the height of engraving elements. Used in conjunction, these microtopographic features made it possible to reconstruct the carving sequences used to produce individual seals. To confirm the link between the above microtopographic features and carving sequences, they were used to reconstruct the known carving sequences used to produce the replicated seals.

Images of the neck hatching from three experimental seals produced by C1 are given in Fig. 3. In all three seals, the shape of the animal was hollowed out before the neck hatching was added, and the neck hatching was created using strokes that proceed from left to right. The microtopographic features in these images reflect this sequence. The hollowed-out animal shape has a greater overall height than the neck hatching, indicated by its red or green colour in the false colour depth maps. The hatches themselves were carved from left to right. Each hatch is cut more deeply into the stone than the one that precedes it to the left. This is why the hatch cuts become deeper shades of blue as they proceed toward the right. Some differentiation of carving phases is also apparent. While the hatch cuts are separated, they share an overall decrease in height. Thus, a portion of the overall operational sequence can be reconstructed based on these images. It is also clear that the same operational sequence was used to produce all three objects.

Fig. 7 illustrates the connection between a sequence of actions in a single carving phase and the microtopography of standards in ES1, ES2, and ES3. These images highlight the overlap between hatch cuts that comprise the detail in the replicated engravings' standards. In all three seals, vertical hatch cuts were made first, proceeding from the left to right. This sequence is indicated by darkening shades of blue. Next, horizontal hatch cuts were created from the top of the standard to the bottom. This is clear in

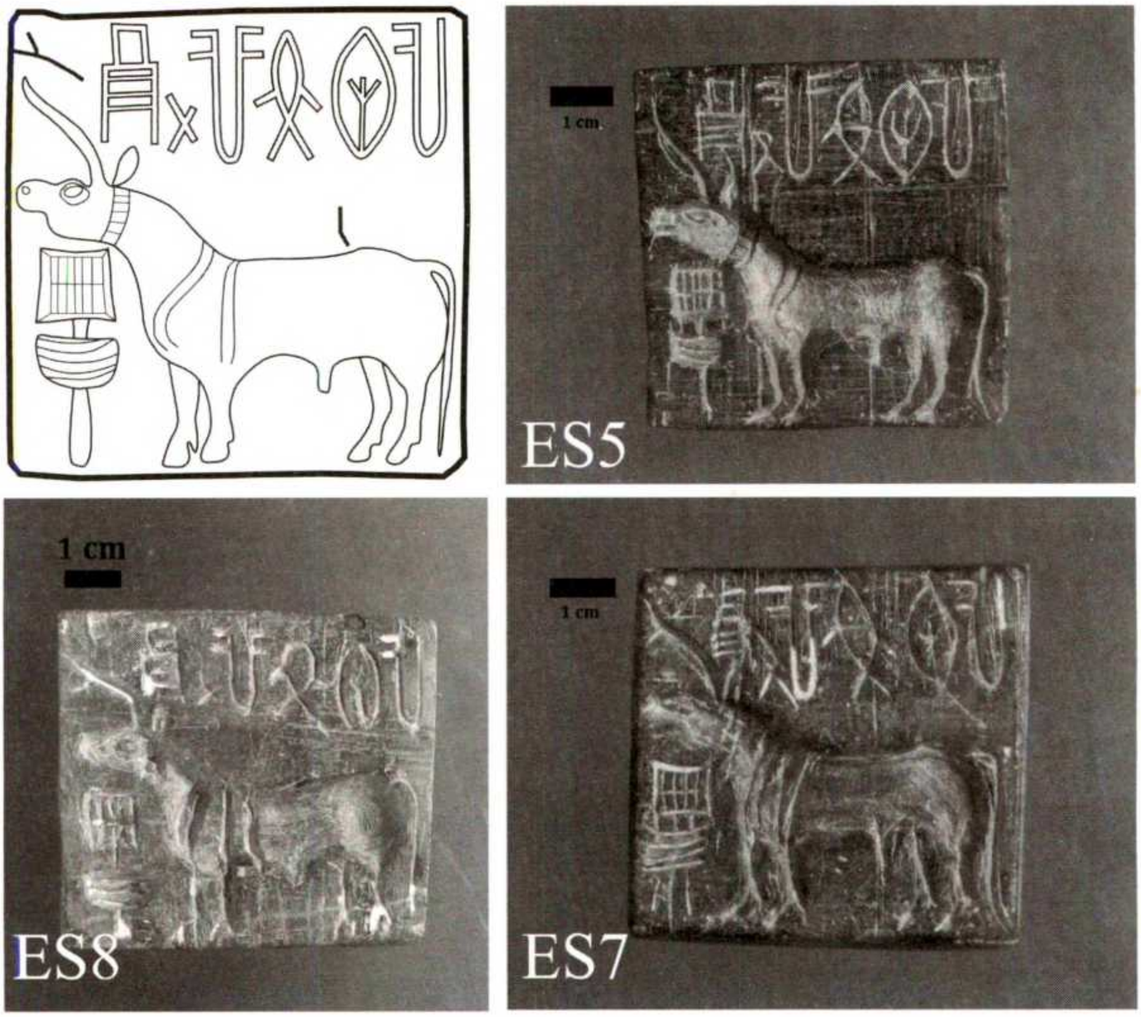

Fig. 5: Exprimental seals 5, 7 and 8 with archaeological referant. Redrawn from Joshi and Parpola (1987)

the false colour image from ES2. The top cut is light blue, and the cut beneath it is much darker, indicating that it has more depth and was carved afterwards. The stereopair images show that the horizontal cuts also overlap the vertical cuts, further indicating that they were carved afterward. While one of the grid squares from ES3's standard has broken off, deepening depth gradients still suggests the sequence by which the hatch lines were carved. All three seals display remarkable uniformity in carving sequence.

While depth gradients and overlapping cuts could be used to reconstruct the carving sequence of ES5 (Carved by C2), a number of challenges are also apparent. The floors of the cuts on some parts of ES5 tend to deepen toward the centre of the cut (Fig. 8) rather than toward the bottom as would be expected if the carver was using a top to bottom stroke. This pattern was produced because C2 used the flat blade of the scraper to create long smooth lines instead of the point of a burin. Additionally, the sequential order of cuts was not always clear given the way they overlapped (Fig. 8). Notice that the horizontal cuts that comprise the details of the top left of the "jar" sign overlap the long vertical cut that constitutes the body of the sign. They do not cut into the floor of the long vertical stroke, making it less clear that they were carved after the body of the sign. Luckily, the stereopair image provides enough additional clues (the presence of steatite debris pushed into the vertical cut from the horizontal cuts) to clarify the sequence of actions used to create the signs. The depth gradient present in the collar of the animal also contradicts the usual top-left to bottom-right directionality observed in other parts of the seal. This is a result of the carver's intense attention to the facial details of the motif.

The features that impede the reconstruction of a seal's carving sequence were localized and easy to recognize. It was therefore necessary to examine most of a seal's engraved surface to gain an appreciation for the overall microtopographic pattern. Also, some features are more easily linked to carving sequence than others. Fig. 9 presents microtopographic features of ES5's surface that were more strongly linked to its operational sequence. The curve of the "fish" sign always has an overlapping intersection of cuts in its centre. Because it always possesses a clear overlap, it tends to reflect the overall microtopography within an engraving. The "fish" sign on ES5 was clearly carved from the bottom left of the sign to the bottom right. This is evident in the colour gradients within the cut and the overlaps between them. Other areas with a large amount microtopographic features, such as the cuts on the animal's withers or the hatching on the standard illustrate the overall top-left to bottom right depth gradients that reflect the sequence of actions used to produce the carving.

After the microtopographic features that are closely linked to operational sequence were identified, two seals from Chanhu-daro's assemblage were examined using the portable version of the H-160. These seals have been given the accession numbers L-176 and L-177 by the University of Pennsylvania's Museum of Anthropology and Archaeology. After examining the entire engraved surface of each seal, 28 images of L-176 and 32 images of L-177 were captured. These images were compared with images from the replicated seals, and similar microtopographic features were identified. Overlapping cuts, depth gradients in the floors of cuts, and differences in overall height were all identified within the microtopography of both seals from Chanhu-daro.

Using experimental data as a comparative baseline, it was possible to identify many of the carving actions that left traces on the surface of each seal. These microtopographic patterns that revealed carving actions are summarized in Figs.10 and 11. These figures were assembled by compiling the microscopic images of each seal's engraving and noting the presence and gradient of all of the observed microtopographic features. Some of the cuts appeared to have been made by strokes moving in multiple directions (see the small arrows within the "fish" sign cuts). This occurs because the floor of each cut sometimes reflects only the last in a series of back-and-forth strokes through the cut. This is why

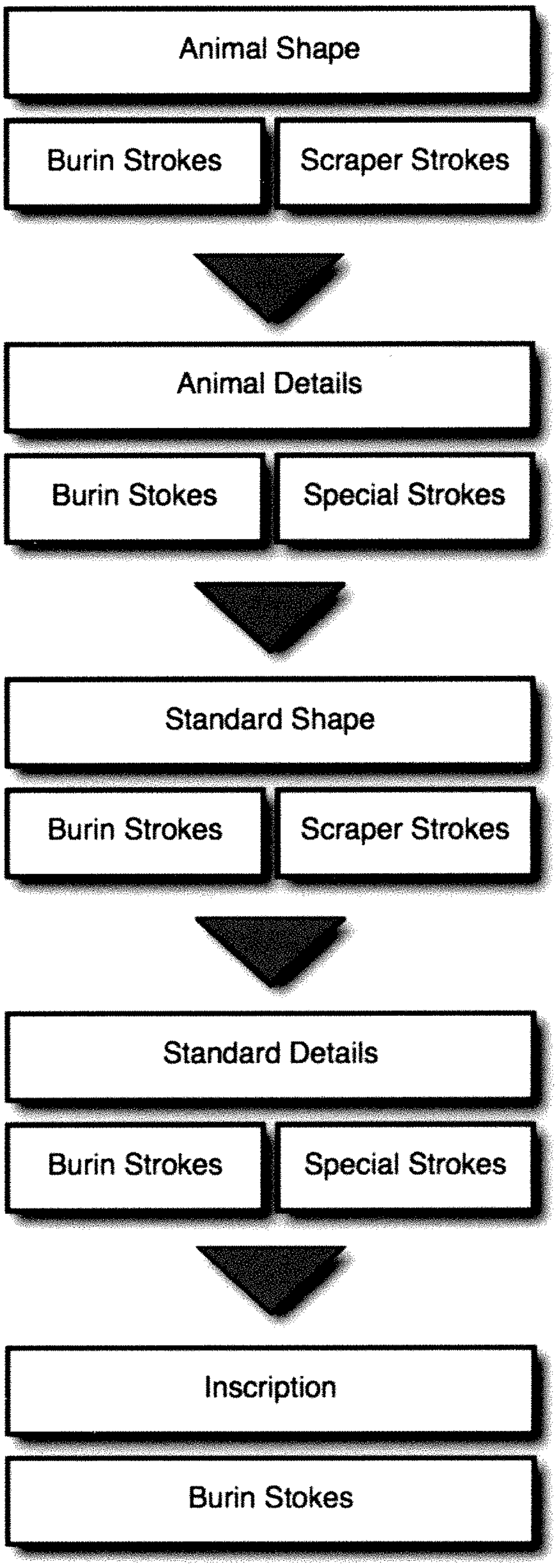

Fig. 6: Carver 1's operational sequence as indicated by time lapse photography.

it is always necessary to consider overlapping cuts when assessing the direction of a stroke.

There were considerable differences in the sequences of actions used to produce L-176 and L-177. In L-176 it is clear that the "fish" sign was carved from bottom left to top right, while in the sequence used to produce the same sign in L-177 proceeded from bottom right to bottom left. The small "v" of the diamond sign was carved before the outline of the sign in L-176, whereas in L-177 the outline was carved first and the small "v" was added later. The strokes used to create the face on L-176 were the same as the basic motions used to create the other features, as indicated by arrows that run in straight or gently curving lines. The carver of L-177 seemed to use a greater variety of strokes to produce the engraving's facial features, as indicated by the swooping scraper stroke used to create the nose and ear. The carvers of L-176 and L-177 clearly used different sets of actions that were organized into different carving phases to create their engravings.

By identifying directional "resets" in the actions used to produce L-176 and L-177, it was possible to reconstruct a number of the carving phases used to produce each seal (Fig. 12). There are significant differences in the conceptual schemes used to produce each object, and these are reflected in the reconstructed operational sequence. These operational sequences are presented as discrete carving phases arranged from start (top) to finish (bottom). Longer boxes reflect the difficulty in establishing the exact point at which a feature was carved, while shorter phases were easier to pinpoint. Overall, L-177 was carved more evenly, with a less orderly progression from one feature to the next. Seal 176's carving sequence was much clearer and more defined, beginning with an outline of the motif and ending with the second line of the withers. In both cases, carvers began work at the top of the animal's head.

Discussion and Conclusions

These contrasting operational sequences undoubtedly reflect important differences in the social and cultural contexts of each seal's production. Considerable social choice is evident in the production of each seal, suggesting that their carvers' relationships with the social representations that underpinned Indus administration were mediated by differing social logics. L-176 comes from an earlier stratigraphic level than L-177, when Chanhu-daro's architecture was most developed and the site expanded to its greatest extent (Mackay 1976). In contrast to the increasing complexity of the site itself, L-176 has a very streamlined conceptual scheme, reflected in a carving sequence that consist a smaller number of simpler actions. L-177 came from a later stratigraphic level (though exactly how much later is unknown), when Chanhu-daro was undergoing considerable reductions in layout and architecture. The conceptual scheme revealed through microtopographc analysis of L-177's engraving was much more complex, with more fluidity between carving phases and a larger number of more precise actions than L-176. While any conclusions derived from such a small sample of the seals at Chanhu-daro are suspect, it is safe to say that the social logics each carver applied to their technological performance are significantly distinct. In future studies that consider larger numbers of seals, these differences will provide a strong basis for the identification of social groups involved in seal production, their relationship to administrative practices in the Indus civilization, and the way these social contexts changed through time.

This pilot study has shown that a new methodology utilizing experimental replication and microtopographic examination of engravings can reveal the operational sequences that underpinned the transformation of social representations into administrative objects. While the results of both the experimental replication project and its archaeological application are preliminary, the precise identification the carving sequences used to produce even a small number of objects raises provocative questions about social and cultural contexts in which each carver worked. Continued research aimed at replicating a greater number of experimental seals using a wider variety of tools and techniques will assist in the precision reconstruction of the operational sequences used to produce more of the seals from Indus assemblages. Once more operational sequences for seals from a variety of archaeological contexts have been reconstructed, it will be possible to identify the social representations that characterized Indus administration. To achieve this goal, more experimental carvers are being recruited, a larger set of tools and techniques are being used in replication, and more archaeological seals are undergoing microtopographic analysis.

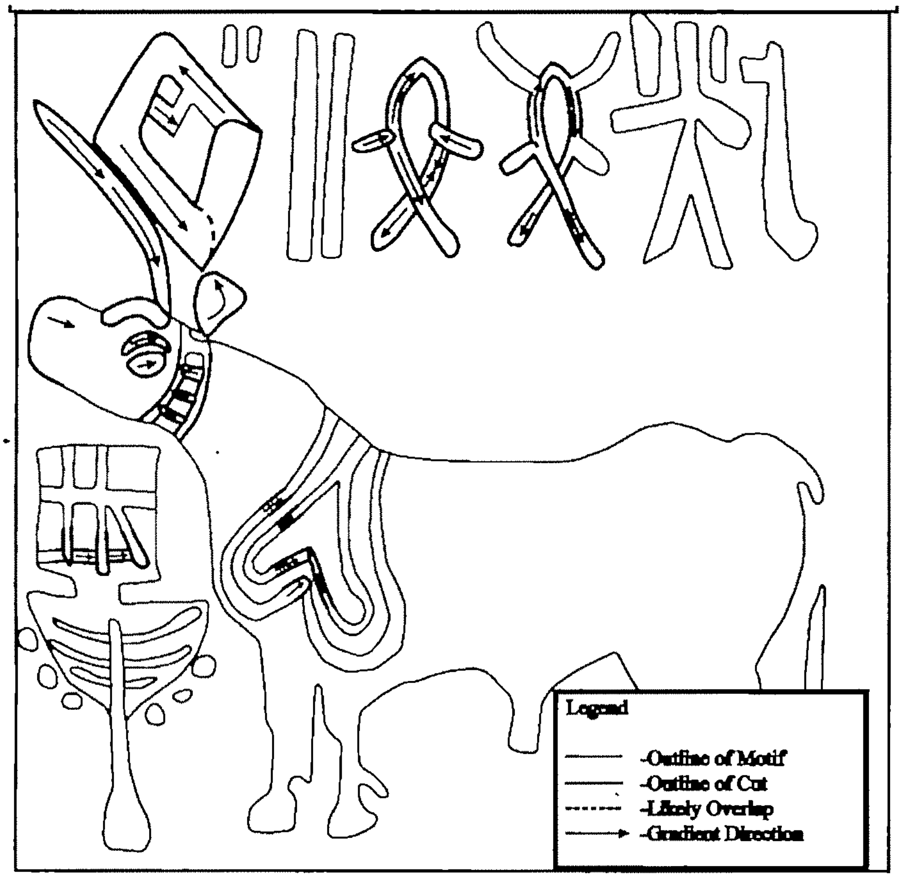

Fig. 10: Summary of microtopographic features on L-176. This image summarizes the microtopographic patterns evident in the microscopic images taken of this seal. Note the consistency of the actions used to create both fish signs.

Wright (2002: 414) calls for an "[e]mphasis on every day happenings and identification of associations at smaller spatial and temporal scales" in an effort to learn about how spatial and temporal variation in technological styles articulate with the social systems in which they operated. The methodology presented here allows just that. Though statistical work on the static attributes of objects in large samples can point toward interesting patterns, envisioning the dynamic, fine-grained technological performance behind the creation of a even a single artifact yields profound insights into the social and cultural contexts of agents in the past (White 1996). By reconstructing the operational sequences used to produce two seals at Chanhu-daro, this pilot study revealed significant diversity in the social logics that mediated the relationships between carvers and the social representations that underpinned the Indus civilization's administrative system.

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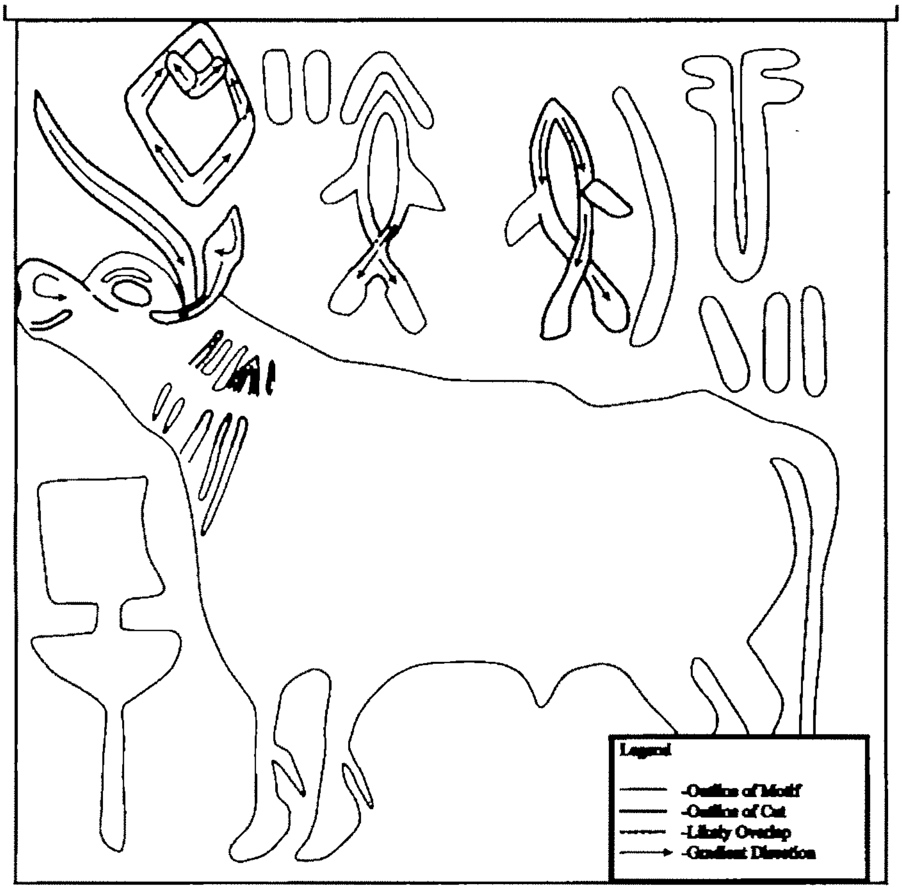

Fig. 11: Summary of microtopographic features on L-177. This summary differs substantially from the microtopographic traces evident on the surface of L-176. The diamond sign exhibits contrasting overlap patterns, and the fish signs were carved in the opposite direction.

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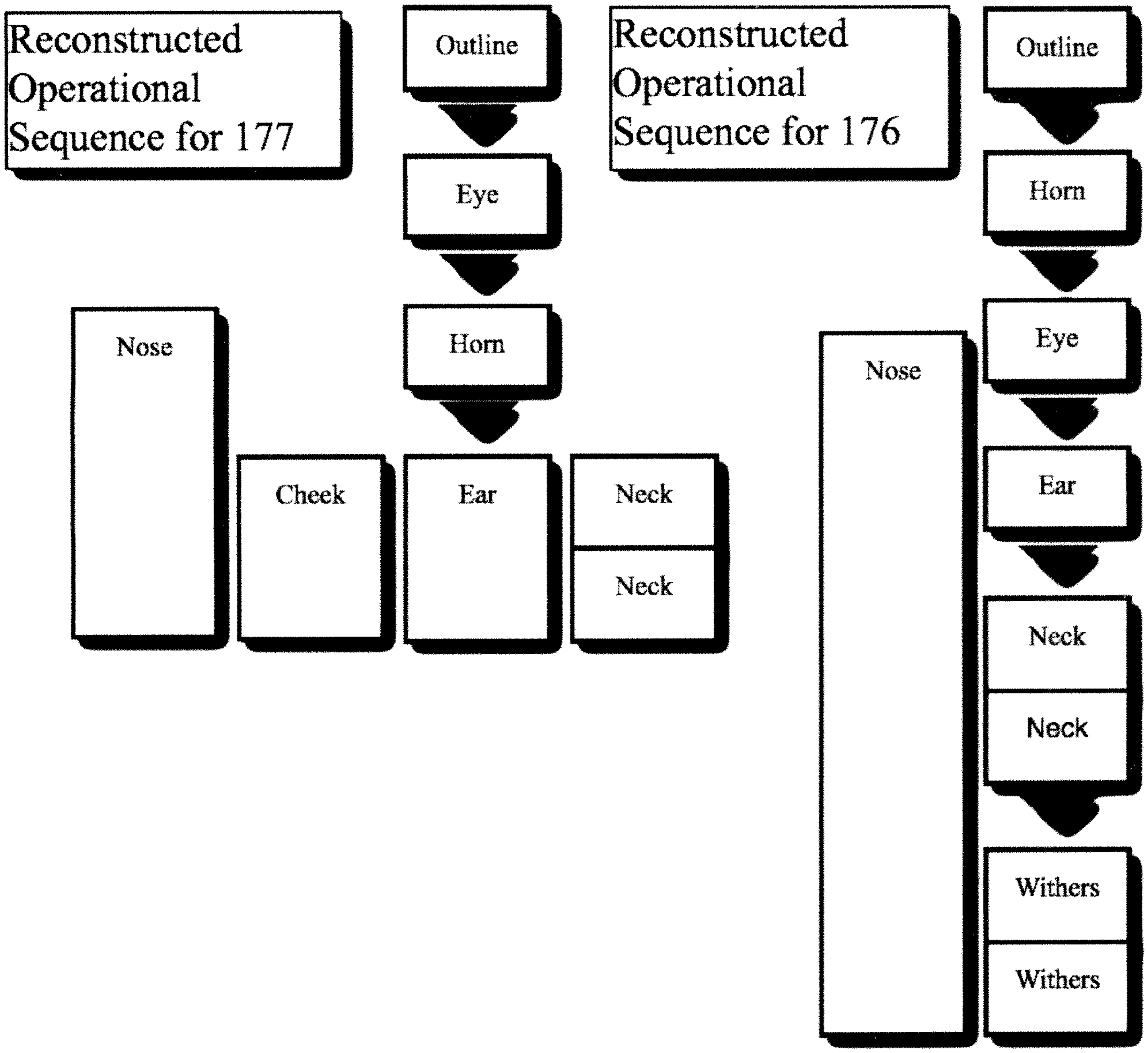
Reconstructed Operational Sequence for 177
Outline
Eye
Horn
Nose
Cheek
Ear
Neck
Neck
Reconstructed Operational Sequence for 176
Outline
Horn
Eye
Nose
Ear
Neck
Neck
Withers
Withers

Fig. 12: Reconstructed operational sequences for L-176 and L-177. There are significant contrasts in each object's operational sequence. L-176's operational sequence is more orderly, with a clear progression from one feature to the next, while L-177's operational sequence is more fluid and complex.

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Further Research into Harappan Metrology at Dholavira

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Abstract

A system of linear units had been earlier proposed for Dholavira's elaborate town-planning and the specific proportions for its successive enclosures. This paper discusses objections to the proposed system, and presents fresh evidence on the accuracy of the published dimensions of Dholavira's fortifications. It then interprets new data about the city's reservoirs in terms of the proposed linear units.

Summary of the Problem

In earlier papers (Danino 2005, 2008, 2010), a system of linear measurements was proposed for the fortifications of Dholavira (Fig. 1), a major Harappan city located in the Rann of Kachchh (23° 53' 10" N; 70° 13' E), discovered by J.P. Joshi in 1967 and excavated by R.S. Bisht in the 1990s (Bisht 1997, 1999, 2000). The system of units was calculated through a simple geometric method which combined the precise dimensions available for the fortifications with the equally precise proportions noted between those dimensions (Fig. 2). Only two assumptions were made: (1) that Dholavira's town planners did use a specific unit of length, 'D', while laying out the city's fortifications, and (2) that most of their dimensions should be expressible as integral (or whole), rather than fractional, multiples of that unit.

With these data, it was shown that the largest possible value of D was 1.901 m. Besides, expressing the city's dimensions in terms of D yielded a high proportion of multiples of 10 (Fig. 3). The average margin of error between the dimensions expressed as multiples of D and their actual values was very low, at 0.6%.

In a second step, it was pointed out that of the four known scale-like objects found at Mohenjo-daro, Harappa, Lothal and Kalibangan, the last two appeared to yield a linear unit of 1.77 cm and 1.75 cm respectively (Mainkar 1984 for Lothal, after correcting an error; Balasubramaniam 2008a, Balasubramaniam and Joshi 2008 for Kalibangan). Taking an average of 1.76 cm, D was found to be precisely 108 times this value, a factor specified by the *Arthashastra* (2.20.19) between a unit called *dhanus* and the *angula*; this definition of the *dhanus* was specifically prescribed for measuring out fortification walls (Kangle 1986: 139).

Beyond Dholavira

Corroborative evidence was offered from other Harappan sites, with over twenty examples of settlement plans or structures reflecting some of the ratios found at Dholavira, and some twenty-five others whose dimensions were expressible as integral multiples of D.

Recent work by Mohan Pant and Shuji Funo (Pant and Funo 2005) on Mohenjo-daro, Sirkap and Thimi was mentioned as further illustration, as it independently produced almost exactly the same results at those three sites (the last two of which are early historical and historical): a master unit of 1.92 m based on 108 *angulas* of 1.78 cm. This was arrived at through an analysis of the grid plans evidenced at those three sites.

Since the publication of one of this author's papers (Danino 2008), the late R. Balasubramaniam attempted to apply the linear units worked out at Dholavira to historical structures: dimensions of the Delhi Iron Pillar (Balasubramaniam 2008b), the Mauryan rock-cut caves at Barabar and Nagarjuni hills (Balasubramaniam 2009b) and the Taj Mahal's modular planning (Balasubramaniam 2009a) took felicitous expressions when formulated in terms of the proposed units, suggesting also a survival of the Harappan system, or of a system akin to it.

Objections

Objections to the Dholavira scheme of units were received by the author directly as well as indirectly from several sources, and are summarized here:

1. Since the four known scale-like Harappan objects point to different units (6.7056 mm at Mohenjo-daro, 9.34 mm at Harappa, 1.77 mm at Lothal and 1.75 cm at Kalibangan), there might not have been standardized Harappan linear units, perhaps even no linear units at all.
2. The measurements of Dholavira's dimensions lack precision, so that calculations made on the basis of published dimensions are not reliable.

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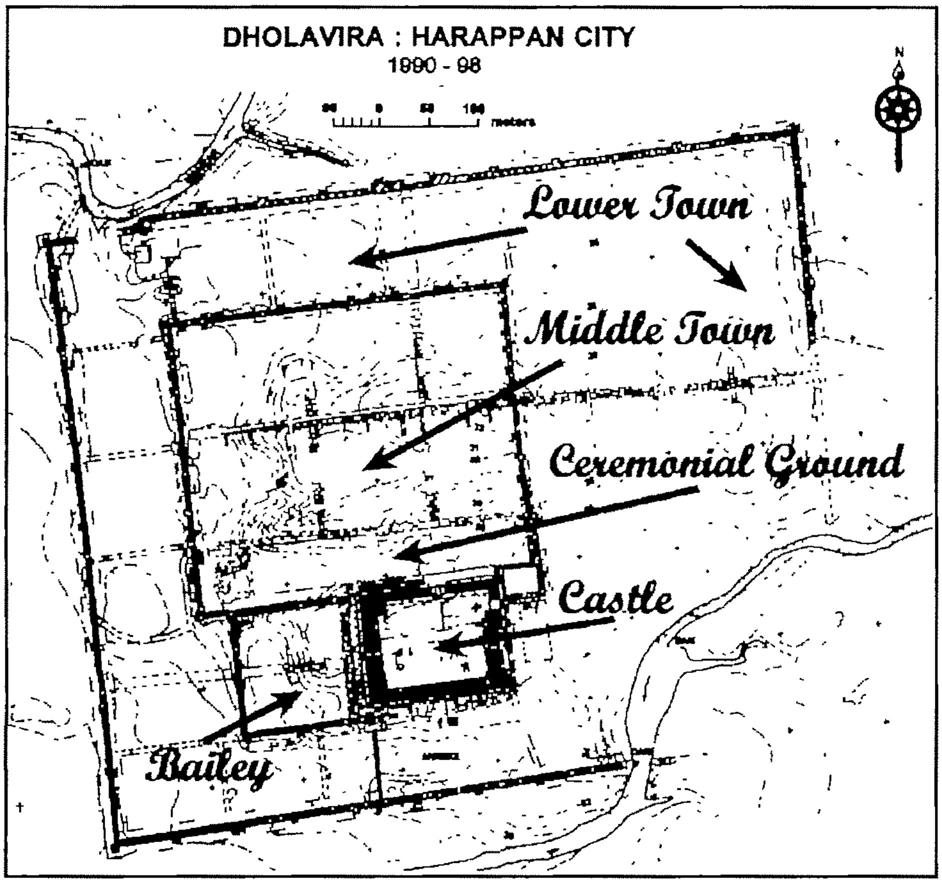

Fig. 1. Plan of Dholavira (adapted from Bisht 1999)

3. In particular, there is no meaning in using dimensions defined to the centimetre, an impossible precision with conventional methods. Similarly, to propose a master unit of 1.901 m, with a precision down to the millimetre, is not warranted.
4. Dholavira's fortifications do not constitute a perfect parallelogram: the northern wall and the reconstructed southern wall of the outer city would have substantially different dimensions; so too with the western wall and the reconstructed eastern wall. Why, then, choose one pair of sides in preference to another? Is it only because the proposed multiples work on the selected pair? A methodology should be clearly defined and adhered to.

Scales and Units

It is true that there is no uniformity among the four objects exhibiting apparent graduations. At this stage, it cannot be proved that any or all were actually meant to be linear scales. However, we can still note the coincidence between the units used in the Kalibangan and the Lothal objects (if we accept Mainkar's proposal (1984: 147) that for the latter we should consider ten graduations, i.e. 1.77 cm). Further, a relationship between the four objects cannot be ruled out; Mainkar again (1984: 146) suggested that 10 Mohenjo-daro units + 15 Lothal units = 10 Harappa units, which, with the *angula* proposed by this author, is verified to 0.1% (Danino 2008: 74). Either this relationship points to a system of units yet to be understood or it is sheer coincidence, in which case the purpose of the graduations on those four objects remains unexplained.

Although this author's earlier papers proposed some evidence regarding a possible Harappan *angula*, it is argued here that the question of smaller and larger linear units should be viewed and tested independently at first, and that the larger units are those easier to test and determine. If this is accepted as a working hypothesis, the question of potential linear scales and smaller units can be taken up in a second stage. This paper concentrates on the larger unit, keeping additional evidence regarding the smaller ones for a later development.

As regards whether the Harappans had linear units at all, an "Indus inch" and "Indus foot" were proposed long ago and are still found in the literature (e.g. Agrawal 2007: 270), but Mackay himself acknowledged that they did not appear to work for actual structures (Mackay 1938: 405). Yet a degree of standardization has long been noted in Harappan town planning in general, in particular in overall

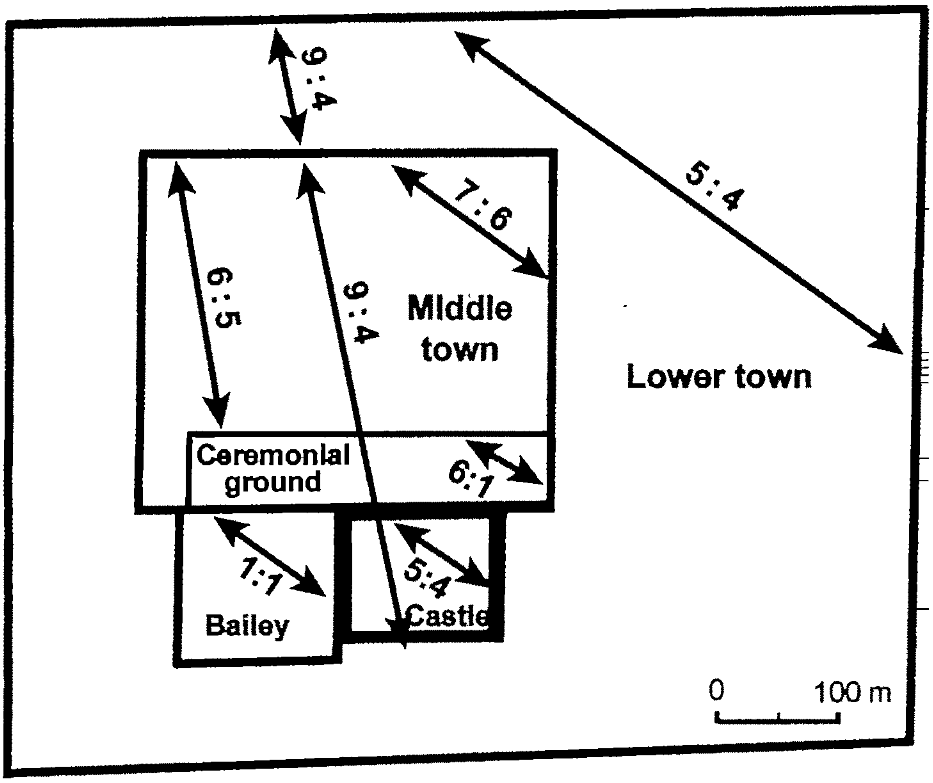

Fig. 2. Main ratios at work in Dholavira

proportions, in house plans or in street widths. It may be argued that all these can be effected with no more than the human hand and step. However, the step varies too widely - even for a single individual - to provide a secure standard over long dimensions. Returning to Dholavira's case, laying out the city's outer dimensions with human steps over an irregular terrain would make it plainly impossible to implement an exact ratio of 5:4. The assumption of a linear unit in this case at least seems to be the only plausible explanation.

First GPS Measurements of Dholavira's Dimensions

As regards the reliability of Dholavira's published dimensions, it may be pointed out that an experienced surveyor working with conventional methods and instruments can easily produce measurements with a margin of error below 0.5%, the margin claimed by the excavator (Bisht 2000: 18). As a matter of fact, Dholavira was surveyed three times by a team led by a senior surveyor of the Archaeological Survey of India using two theodolites (Bisht, personal communication 2009).

Further, it is easy to verify that the published plan coincides well with a satellite view of the site. In Fig. 4, a view from Google Earth was superimposed over the published plan (Fig. 1), whose fortifications and streets were redrawn identically over the satellite view without any skewing: only proportional scaling and rotation were used (a multi-layer colour digital file is available with the author). Keeping in mind that some distortion is introduced by the satellite's viewing angle, and that the satellite view tends to reveal contrasts in vegetation rather than the actual fortifications, the match is excellent.

It remains true, however, that a survey of Dholavira with a total station coupled with GPS is called for. Pending this, a partial reading of three main dimensions was made on 16 March 2009 by M.S. Gadhavi of the Institute of Seismological Research, Gandhinagar, in the presence of R.S. Bisht, R.N. Iyengar (of the Indian National Academy of Engineering) and this author, using a hand-held GPS with an estimated precision of 0.15%. The results are edifying:

- Length of the city (northern wall, inner measurement): 770 m. Compared to the published dimension of 771.1 m, the difference is 0.1%.
- Width of the city (western wall, inner measurement): 616 m. Compared to the published dimension of 616.85 m, the difference is again 0.1%.
- Width of the middle town (its northern wall, outer measurement at the edges of the bastions): 356 m. Deducting 3 m for each bastion's projection and 4.2 m for each wall (measured on the spot), the middle town's inner width is 341.6 m. Compared to the published value of 340.5 m, the difference is 0.3%.

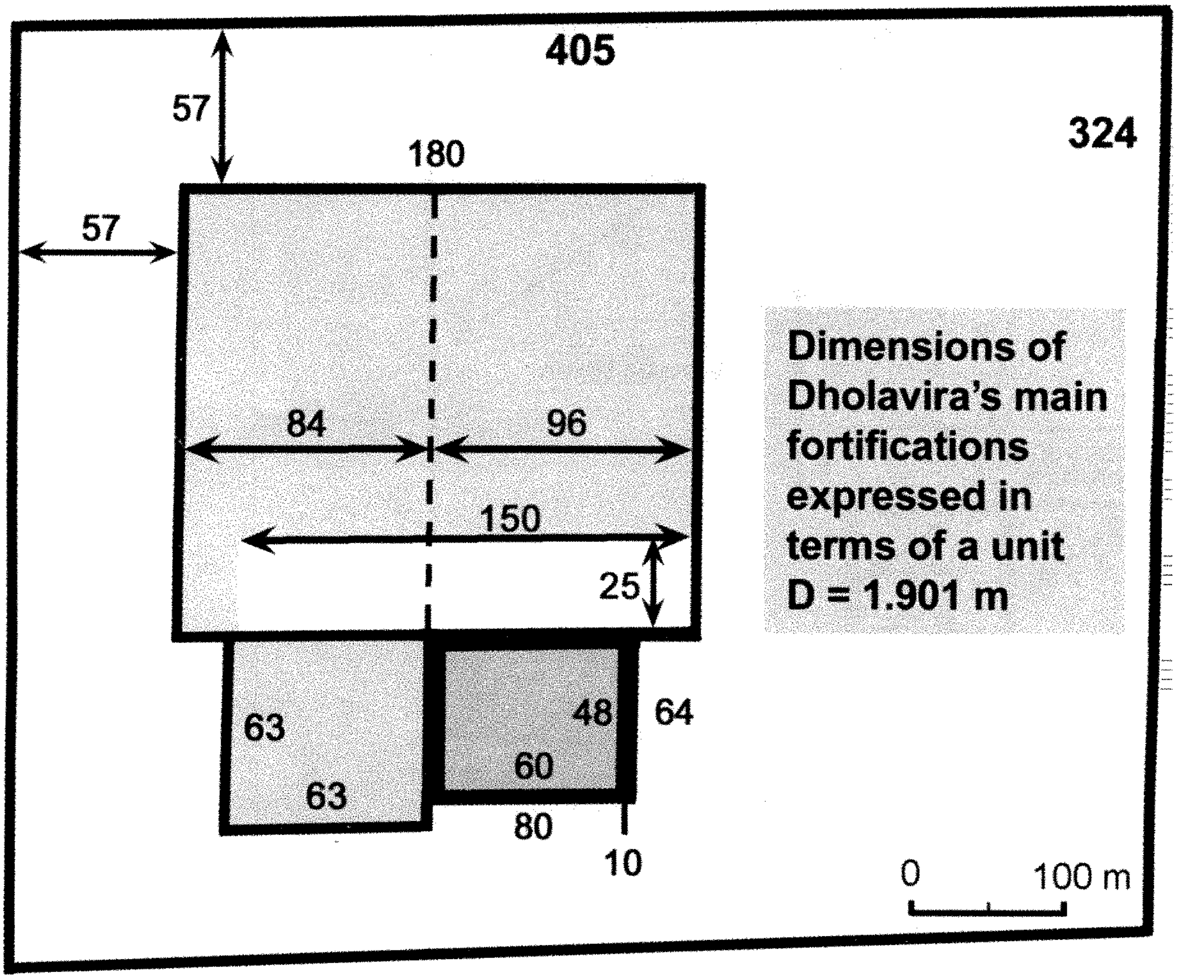
405
324
57
57
180
84
96
150
25
63
63
48
60
80
64
10
Dimensions of Dholavira's main fortifications expressed in terms of a unit D = 1.901 m
0
100 m

Fig. 3: Dholavira's main dimensions expressed in terms of D, a proposed unit calculated to be 1.901 m

The match with the published dimensions is remarkable and well within the published margin of error of 0.5%. This testifies to the accuracy of the ASI surveyors' work at Dholavira. Pending a complete resurvey, the published dimensions can therefore be accepted as correct within the claimed margin of error. Fig. 5 plots the points where the measurements were taken (the plotting is generated automatically by merging the GPS data file with the Google Earth view).

Of great relevance to this study is the confirmation of the ratio between the city's overall dimensions: 770 / 616 = 1.25 exactly. This ratio, which can also be expressed as 5:4, was noticed by Bisht not only here but between the castle's inner as well as outer dimensions. It was also shown (Danino 2008: 70) to govern Lothal's and Juni Kuran's overall dimensions, and those of a few important structures. Besides, we find 5 salients on the northern wall of Dholavira's middle town, against 4 on its eastern and western walls; at Mohenjo-daro, the "assembly hall" or "pillared hall," located on the southern part of the acropolis, had four rows of five pillars each. The overall evidence strongly suggests that 5:4 is a key ratio in the Harappan mind and that its architectural use is deliberate, not accidental.

How Many Decimals?

Dholavira's published dimensions do not follow a common standard as regards the number of decimals; e.g. 616.85 m for the city's width, but 283 m for the ceremonial ground's length. This can be explained by the fact that some of the corners where measurements were taken are better defined than others; nevertheless, it is true that a measurement to the centimetre cannot be significant. Although it would have been more elegant to keep a single decimal for all dimensions, it makes no difference in practice.

The objection against keeping three decimals in the proposed unit of 1.901 m misunderstands the mathematics of error. It is not suggested that Harappans were aware of the millimetre; if the unit is valid, they simply viewed it as "1 something". The decimals only reflect the high precision in the city's dimensions. If we take the outer length (405 such units, in the proposed system), the second decimal

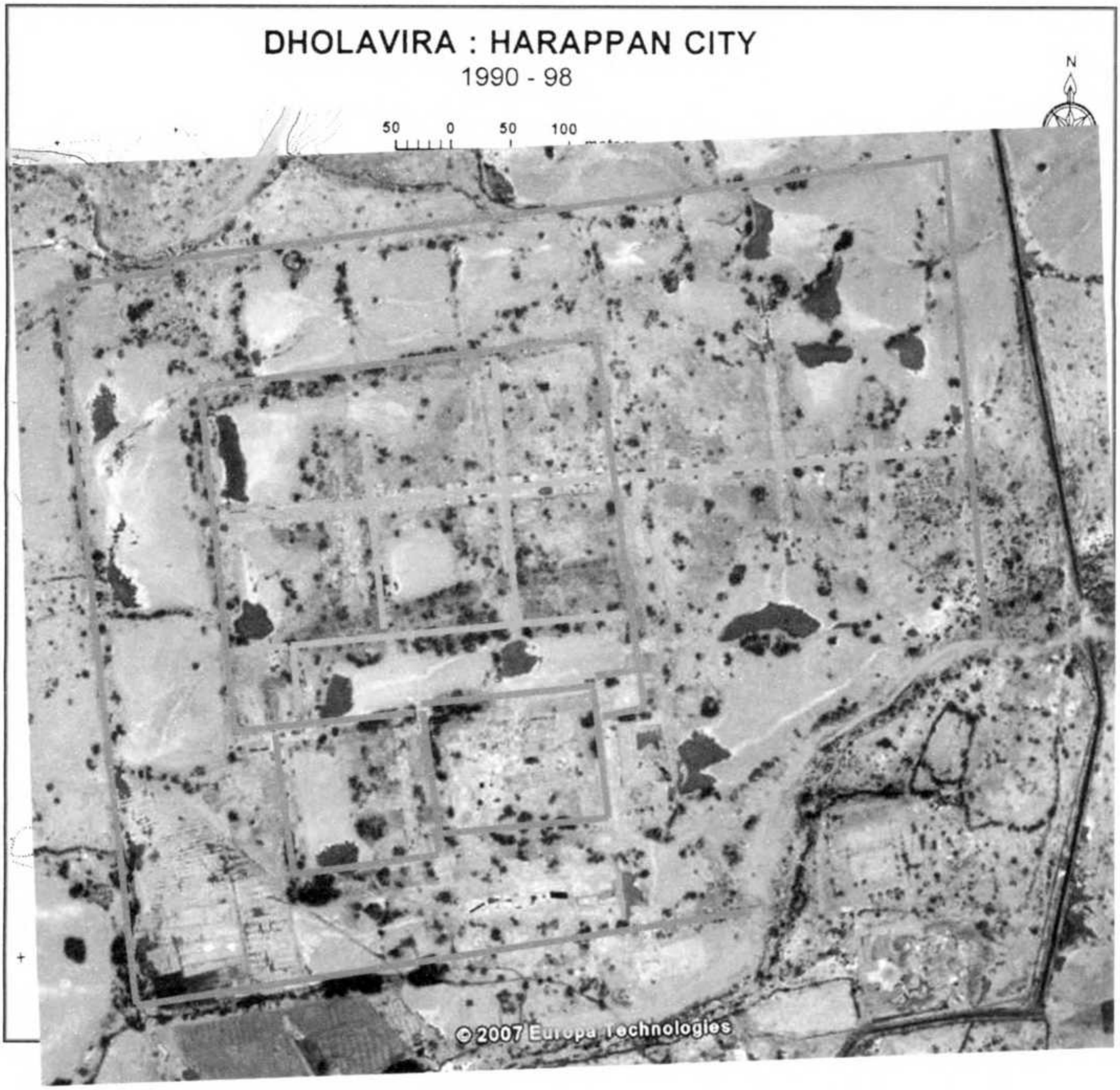

Fig. 4: Comparing Dholavira's plan with a satellite view of the site

place corresponds to a margin of error of 0.01 x 405 = 4 m or 0.5% and is therefore significant. The third decimal corresponds to 0.05% and will generally not be significant, but neglecting it could, in certain situations, introduce an undesirable round-off error. Thus, while keeping in mind that 1.90 m will do in most cases, there is no harm in tentatively retaining the third decimal and testing it against fresh evidence. For instance, the published dimension of the city's length, 771.1 m, first yielded a unit of 1.904 m, although other considerations (Danino 2008: 74) had appeared to point to 1.901 m, which was tentatively adopted; now the GPS reading of 770 m, divided by 405, yields the same 1.901 m, suggesting that the third decimal deserves to be retained until further testing.

Which Side of the Fortifications? The Question of Methodology

It is true that Dholavira's overall plan is slightly asymmetrical. Its south-eastern corner having been eroded away, we can form a rough estimate of the dimensions of the city's southern and eastern fortifications by extrapolating from the plan. Measurements made on a digital scan of it yield about 750 m and 613 m respectively,

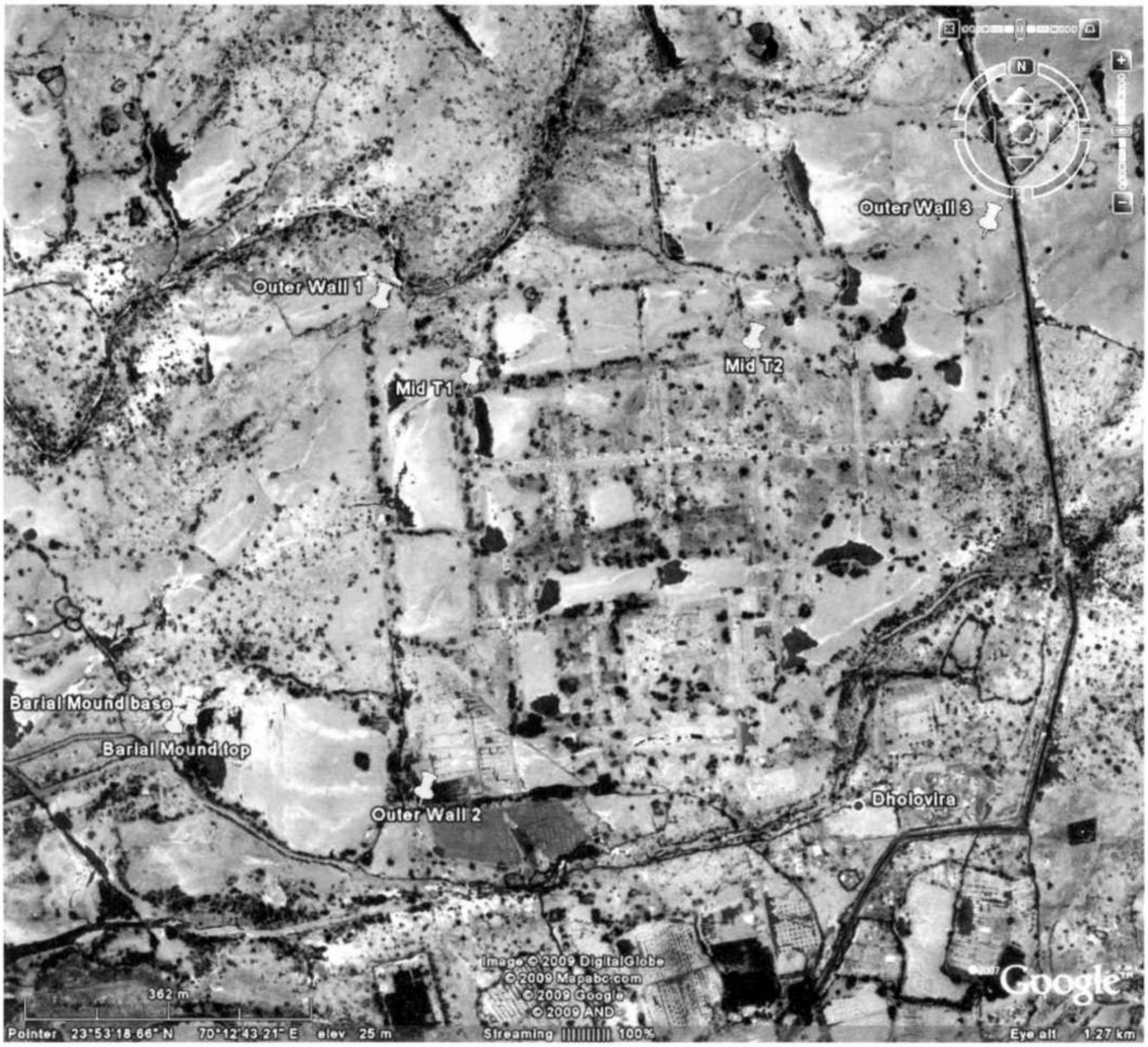

Fig. 5: Plotting GPS measurements (courtesy M.S. Gadhavi) of Dholavira's three major dimensions on a satellite view

2.6% and 0.5% shorter than the opposite sides. Moreover, the ratio between these two sides is 1.22, no longer a perfect 1.25. It is thus clear that using these two sides in our calculations will yield substantially different, and less satisfactory, results. But why not use them, or an average between opposite sides?

The answer takes us back to the issue of ratio. Either the overall ratio of 5:4 is accidental — in which case all other 10 such ratios noticed in Dholavira's plan, 9 of them with a margin of error below 1% (Danino 2008: 68), must be equally accidental —or it is intentional, in which case it is justifiable to use the set of dimensions that reflect it more accurately, i.e., the northern and western outer fortifications.

The methodology proposed here therefore rests on the following working hypotheses: (1) Harappan architects were keen to integrate specific ratios in major plans or constructions; some of them, such as 1:2 or 3:2, were noted earlier, but it is proposed that they used many more. (2) Wherever such a ratio is clearly discernible, i.e., with a low margin of error, the dimensions that reflect it best should be selected for testing under the proposed system of linear units; if one dimension can additionally be expressed as a whole multiple of D, the result may be taken to be significant (both cannot be expected to do so, since they would be related through the observed ratio, which generally will lead to fractional results). Consistency in results will be the ultimate test.

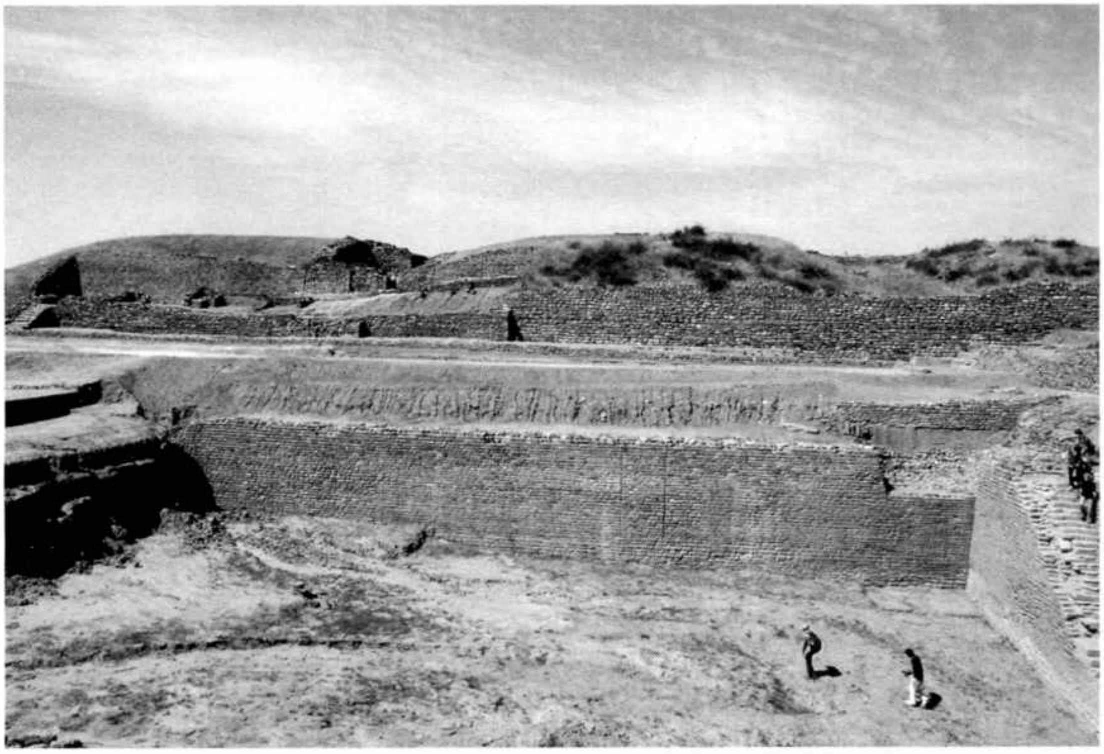

Fig. 6: A view of Dholavira's eastern reservoir (author's photo)

Evidence from Dholavira's Reservoirs

Let us use this methodology while studying some of Dholavira's imposing reservoirs. All dimensions are by courtesy of R.S. Bisht (personal communication, 2009) and, in some cases, supersedes the dimensions published in his as well as this author's previous papers.

- The colossal **eastern reservoir** (Fig. 6) must have had a capacity exceeding 25,000 cubic metres. Its length is 73.40 to 73.50 m at top and 70 m at bottom, while its width is 29.30 m at top and 27.70 to 27.75 m at bottom (at a depth of about 10 m). The top dimensions reflect a ratio of **5:2** or 2.5 with a very low margin of error (0.3%) which, again, points to a deliberate design. The margin of error increases to 1% at the bottom. Let us note, however, that neither top nor bottom are final: the reservoir's topmost portion (including a probable embankment) was eroded away while the bottommost is yet to be excavated. Therefore, while we get a splendid confirmation of our hypothesis about ratios, testing our proposed unit is more difficult. If, as seems to be the case, the ratio 5:2 was imposed at the top, we may assume that this was roughly 2 m higher than the extant top level. A simple extrapolation leads to a length of about 74.1 m, which can be expressed as **39 D** with a nil margin of error. However, the extrapolation is clearly tentative. As regards ratio 5:2, it is interesting that it was found reflected in the rooms of Harappa's "granary" (Danino 2008: 70) but not, so far, at Dholavira.
- Several reservoirs have been excavated south of the Castle (with probably a few more still buried towards the south-east). Let us study them from east to west. Southern reservoir **SR1** has a length of 30.35 m and a width of 13.90 m. The proportions appear to point to a ratio of **9:4**, a ratio found twice in Dholavira's dimensions, but with a high margin of error (3%). The reservoir's dimensions, however, are again merely at the extant top level. On the other hand, the length is almost exactly **16 D** (0.2%).
- **SR2** is actually a shallow and oblong siltation channel, with a length of 9.6 m and a width of about 4.5 m. There is no clear ratio in its proportions (it may have been a rough 2:1), but the length happens to be close to **5 D** (1%).
- **SR3** (Fig. 7) is the famous rock-cut reservoir with a secondary reservoir cut at the bottom, at an angle. Because of the well-defined dimensions, it offers an interesting double case study. The length of the primary reservoir is 33.40 m and its width 9.45 to 8.90 m. Adopting the former yields a ratio of 7:2 (1%), while the latter points to 15 : 4 (0.1%). While the length is not an integral multiple of D, the maximum width is **5 D** (0.5%), suggesting that the ratio of **7:2** was intended.
- **SR3's secondary reservoir** measures 15.50 m in length at the bottom and 5.65 m in width at the bottom (dimensions at the top are not available, but

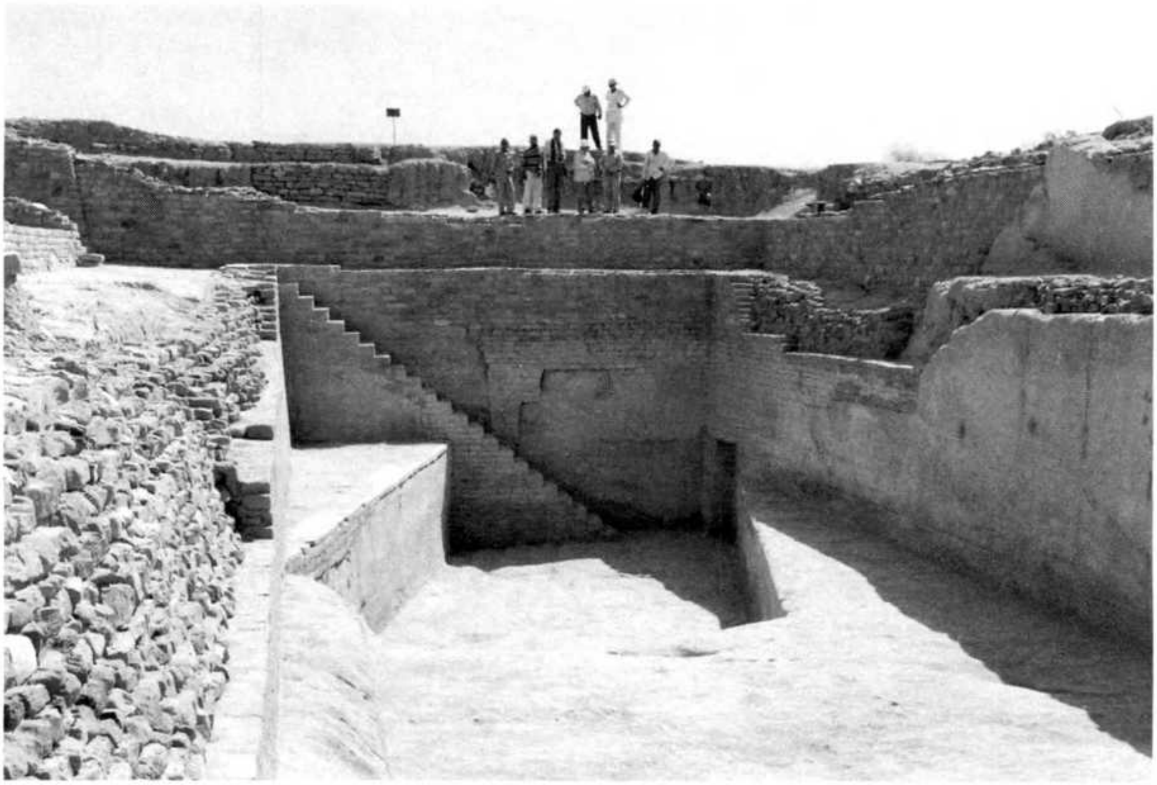

Fig. 7: A view of Dholavira's SR3 southern reservoir (author's photo)

only slightly larger). This yields a precise ratio of **11:4** (0.2%). Moreover, the width is very close to **3 D** (0.9%); the match would be closer at the top if the width is larger there by a few centimetres (1.9 x 3 = 5.7 m), which is likely to be the case.

- **SR4** is 11.40 m to 10.34 m in length, and 7.95 m to 7.10 m in width, therefore not a perfect rectangle. While a general ratio of **3:2** seems intended, it is difficult to decide where to fix it. However, the greater length happens to be exactly **6 D**. Applying the ratio, the width would be 4 D or 7.6 m, more or less the average width.
- **SR5**, with a length of 16.35 m and a width of 11.10 m yields a ratio also close to 3:2 (1.8%), but its dimensions do not take integral expressions of D. In fact, the reservoir is much more irregular than the data suggest; it is either an unfinished reservoir, or one that was not regarded as important enough to be polished.

What emerges from our study of these seven reservoirs is that whenever they are reasonably well defined, a clear ratio emerges. This is indisputable at the eastern reservoir (5:2) and at SR3 (7:2 and, more so, 11:4). In the seven reservoirs considered, at least six dimensions could be expressed as an integral multiple of D with a low margin of error, a situation unlikely to be random: it must be understood that we are not dealing here with long dimensions such as the city's fortifications, but with much smaller ones; therefore the probability of stumbling on integral multiples is much lower. Among the smallest dimensions available, the well-defined width of SR3's secondary reservoir, equal precisely to 3 D, offers a strong corroboration of the proposed system.

Conclusions

The new data on Dholavira — the GPS readings as well as the reservoirs' dimensions — provide fresh support to the proposed system of ratios and to the proposed linear unit D = 1.901 m. Three ratios (5:2, 7:2 and 11:4) found in the reservoirs had not emerged at Dholavira in our earlier study. Plotting all ratios noticed so far at all sites on a linear scale (Fig. 8) gives a graphic illustration of what we might now call a Harappan obsession with specific proportions — without it, we would see a random pattern along the same scale. Such proportions must have been viewed as auspicious or sacred.

To supplement this study, three aspects are clearly called for:-1) a new look at he smaller units proposed earlier, in particular the proposed Harappan *angula*; 2) Two, a probabilistic study: what is the likelihood that all the ratios and integral multiples noted at Dholavira could be a random phenomenon?; 3)a statistical study. It is proposed to take these aspects up for study subsequently.

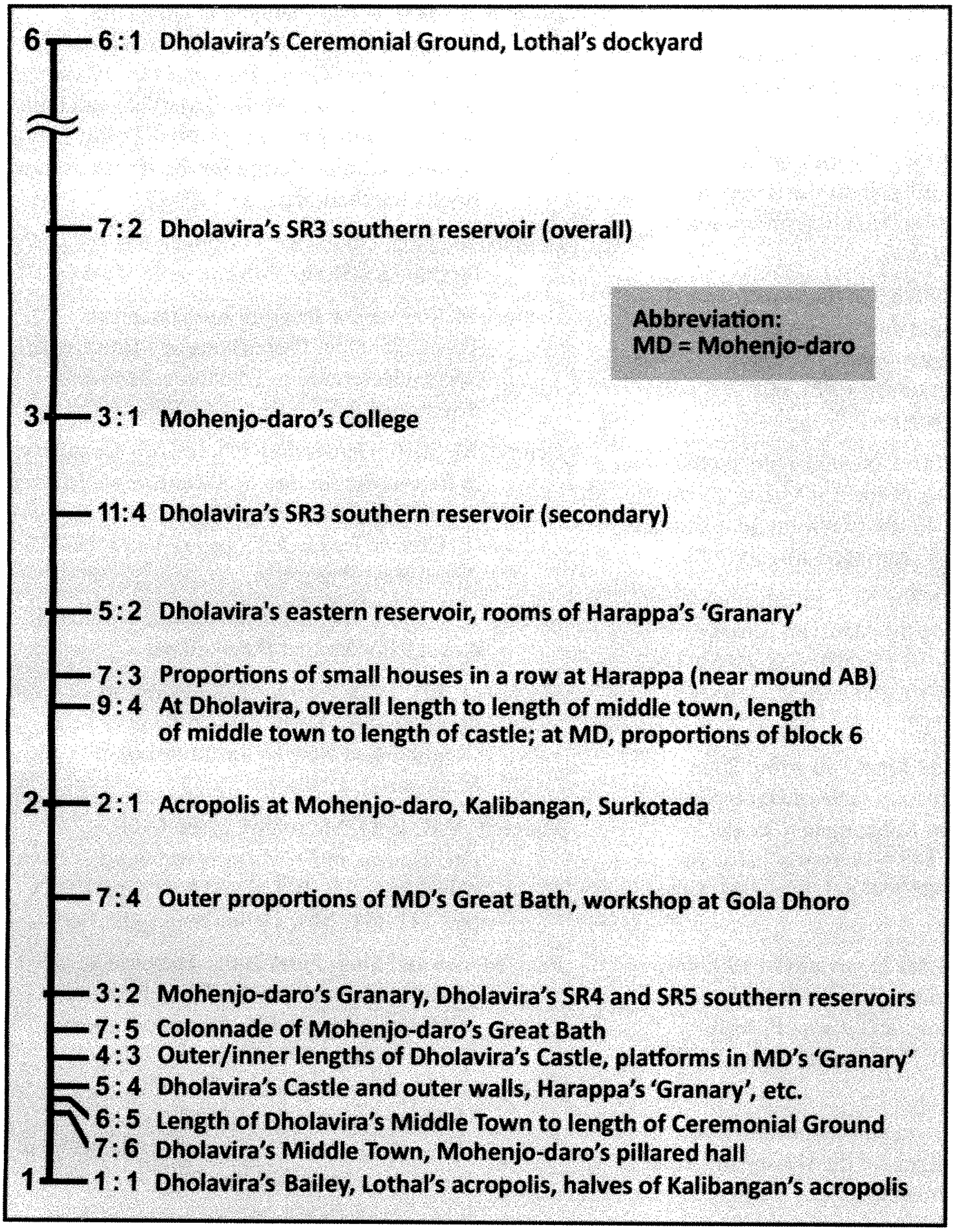
6
6 : 1 Dholavira's Ceremonial Ground, Lothal's dockyard
7 : 2 Dholavira's SR3 southern reservoir (overall)
Abbreviation:
MD = Mohenjo-daro
3
3 : 1 Mohenjo-daro's College
11:4 Dholavira's SR3 southern reservoir (secondary)
5 : 2 Dholavira's eastern reservoir, rooms of Harappa's 'Granary'
7 : 3 Proportions of small houses in a row at Harappa (near mound AB)
9 : 4 At Dholavira, overall length to length of middle town, length of middle town to length of castle; at MD, proportions of block 6
2
2 : 1 Acropolis at Mohenjo-daro, Kalibangan, Surkotada
7 : 4 Outer proportions of MD's Great Bath, workshop at Gola Dhoro
3 : 2 Mohenjo-daro's Granary, Dholavira's SR4 and SR5 southern reservoirs
7 : 5 Colonnade of Mohenjo-daro's Great Bath
4 : 3 Outer/inner lengths of Dholavira's Castle, platforms in MD's 'Granary'
5 : 4 Dholavira's Castle and outer walls, Harappa's 'Granary', etc.
6 : 5 Length of Dholavira's Middle Town to length of Ceremonial Ground
7 : 6 Dholavira's Middle Town, Mohenjo-daro's pillared hall
1
1 : 1 Dholavira's Bailey, Lothal's acropolis, halves of Kalibangan's acropolis

Fig. 8: A summary of Harappan ratios so far, on a linear scale

Acknowledgements

This paper is dedicated to the memory of Prof. R. Balasubramaniam, whose warm encouragement to the author's research is gratefully acknowledged. The Indian National Academy of Engineering's assistance in facilitating a field visit to Dholavira on 16 March 2009 is thankfully acknowledged; I am especially grateful to Prof. R.N. Iyengar, chairman of the Indian Engineering Heritage (Civil) Group of the INAE. I am greatly indebted to Dr. R.S. Bisht for kindly consenting to be part of the visiting team, and for sharing unpublished data on the dimensions of Dholavira's reservoirs. I am also much obliged to M.S. Gadhavi, scientist at Institute of Seismological Research, Gandhinagar, for his assistance in establishing the first GPS readings of some of Dholavira's dimensions.

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Review of Archaeological Investigations in the Protohistoric and Historical Archaeology of Vidarbha

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Abstract

During the colonial and post-colonial periods, the study of protohitoric and historical archaeology in Vidarbha witnessed various phases of research. This paper endeavors to understand research concepts and contributions at individual and institutional levels, since the beginning of antiquarian studies in this region.

Introduction

The region of Vidarbha forms the eastern part of Maharashtra, India. Protohistoric Chalcolithic human settlements in this region began around the first millennium BCE, as noted at sites such as Adam (IAR 1990-91, 1991-92), Arambha (IAR 1991-92), Shirkanda (IAR 1991-92), and Tuljapur Garhi (Bopardikar 1996). However at most sites, human occupation started from the Iron Age (c. 800-700 BCE) characterized by megalithic burials; which barring a few exceptions are not observed in other parts of Maharashtra. Research into the protohistoric and historical archaeology of India in general and of Vidarbha in particular, witnessed various phases of development during the colonial and post-colonial periods; owing to changing conceptual and analytical approaches. This paper attempts to review these seminal contributions at individual as well as institutional level, results of important excavations and changes in research outlooks along with investigation methods in the field of protohistoric and historical archaeology, in Vidarbha since the 19th century.

Excavations

Excavations in various parts of Vidarbha carried out by the Archaeological Survey India (hereafter ASI), Maharashtra State Department of Archaeology and Museums (hereafter MSDAM), Nagpur University, Deccan College, and efforts made at individual levels (especially during the colonial period) are worth mentioning (see Table 1).

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In recent years, a few more sites have been excavated, viz., Vyahad (Megalithic site) by Nagpur University, Bhandak (Early Historic site) by MSDAM and Nagpur University, and Chandankheda (Early Historic site) by Nagpur University and MSDAM; but their reports are yet to be published.

Phases of Development

In the following paragraphs we briefly discuss various phases of development, from the earliest to recent times, of protohistoric and historical archaeology in Vidarbha.

Phase I. The Beginning: Individual Efforts (1850-1870)

Rev. Hislop

Rev. Hislop (1817-1863) (Scottish Missionary) was a well known evangelist, educationist[1] and a geologist. His important contribution is in geological research in the Nagpur area (Hislop 1857, 1861a, 1861b). Apart from his extensive geological research, he also excavated a stone circle near Nagpur. The details of the excavation were published in the form of a letter in 1857 in *Journal of Bombay Branch of Royal Asiatic Society*. In the letter, he refers to his excavations at Takalghat and general abundance of these burial remains in the Nagpur district. The paragraph in his letter reads:

> [...] Several years ago I dug it out of a Scythian stone-circle, at Takalghat, 20 miles S. of Nagpur. When it was brought to light, at the height of about half an inch from the bottom it was covered over with fragments of pottery fitted to each other so as to form

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[1] There is a college named after him in Nagpur.

Table 1: Details of the Excavated Sites in Vidarbha

Site*	**District**	**Excavating Agency/ person**	**Reference**
Takalaghat	Nagpur	Rev. Hislop	Hislop 1857: 671-72
Wurreegaon (Kamptee)	Nagpur	G.G. Pearse	Pearse 1869: 207-217
Khairwada (also spelt as Khaiwarra) (21° 1' N; 78° 29'E)	Wardha	First by J.J. Carey; Later by Deccan College and MSDAM	Carey 1871: 238-39; IAR 1981-82: 51-52
Junapani	Nagpur	First by Rivett-Carnac; Later by ASI	Rivett-Carnac 1879; IAR 1961-62: 32-33
Kaundinyapur (20° 55' N; 78° 05' E)	Amravati	First by MSDAM; Later by Deccan College	Dikshit 1968; Mishra *et al.* In press. (also see Smith 2001)
Paunar (20° 47' N; 78° 41' E)	Wardha	Nagpur University	Deo and Dhavalikar 1968
Takalghat-Khapa (20° 54' 40" N; 78° 56' 30" E)	Nagpur	Nagpur University	Deo 1970a
Pauni (20° 48' N; 79° 39' E)	Bhandara	First by Nagpur University and ASI; Later by ASI	Deo and Joshi 1972; Nath 1998
Mahurjhari (21° 14' N; 79° 30' E)	Nagpur	First by Nagpur University; Later by Deccan College	Deo 1973a; IAR 2001-02: 123-128; IAR 2002-03: 172-174; Mohanty 2002, 2003a, 2003b
Mandhal	Nagpur	Nagpur University	Shastri 1978
Arni (20° 4' N; 78° 57' E)	Yavtmal	Nagpur University	IAR 1978-79: 71-72, IAR 1984-85: 55-56
Nagra	Gondia (earlier in Bhandara)	MSDAM	IAR 1979-80: 56; IAR 1980-81: 40
Boregaon (21° 20' N; 78° 55'E)	Nagpur	Deccan College and MSDAM	IAR 1980-81: 40
Naikund (21° 20' N; 79° 10' E)	Nagpur	MSDAM and Deccan College	Deo and Jamkhedkar 1982
Bhagi Mahari (21° 24' N; 78° 51' E)	Nagpur	MSDAM and Deccan College	IAR 1982-83: 61-62, IAR 1983-84: 57-58
Mulachera (19° 41' N; 80° 01'E)	Gadchiroli	MSDAM	IAR 1988-89: 49, IAR 1987-88: 84
Adam (21° 00' N; 79° 28' E)	Nagpur	ASI	IAR 1988-89: 50-62; IAR 1990-91: 45-50; IAR 1991-92: 63-68; Nath 1992a: 69-79
Tharsa (21° 15' N; 21° 15' E)	Nagpur	Nagpur University	IAR 1989-90: 58-60
Arambha (20° 34' N; 78° 59' E)	Nagpur	ASI	IAR 1991-92: 73-74
Shirkhanda	Nagpur	ASI	IAR 1991-92: 68-69
Raipur (21° 43' N; 78° 58' E)	Nagpur	Deccan College	Deglurkar and Lad 1992
Pachkheri (20° 55'N; 79° 30'E)	Nagpur	ASI	IAR 1992-93: 64-73
Bhawar (20° 52' N; 79° 44' E)	Bhandara	ASI	IAR 1992-93: 55-62
Mansar (21° 24' N; 79° 17' E)	Nagpur	ASI	IAR 1994-95: 55-57; IAR 1997-98: 129-133; IAR 1998-99: 114-116; IAR 1999-2000: 103-106; Joshi and Sharma 2000: 127-131; 2005: 1-26
Tuljapur Garhi (21° 12' N; 77° 38' E)	Amaravti	ASI	Bopardikar 1996
Hamlapuri	Nagpur	MSDAM	Sali 1998
Washim	Washim	MSDAM	Sali 1998
Vivekanandpur	Gadchiroli	MSDAM	Sali 1998

Site*	District	Excavating Agency/ person	Reference
Bramhapuri (20°37' N; 79°50' E)	Chandrapur	Deccan College	Walimbe 2003: 39-40
Dhamma (Ling) (21° 8'30' N; 78° 51' E)	Nagpur	Nagpur University	IAR 2001-02: 121-123, IAR 2002-03: 168-172; Gupta and Ismail 2005: 51-65
Paturda (76° 44'E; 20° 57'N)	Buldana	Deccan College	Deotare 2007
Bhon (20° 55' N; 76° 39' E)	Buldana	Deccan College	Deotare 2007; Deotare *et al.* 2007: 177-185; Deotare *et al.* 2008: 210-216
Kholapur (20° 57' N; 77° 31' E)	Amaravati	Deccan College	Deotare 2009: 63-66

* latitude & longitude are given wherever available; sites are arranged as per their year of publication

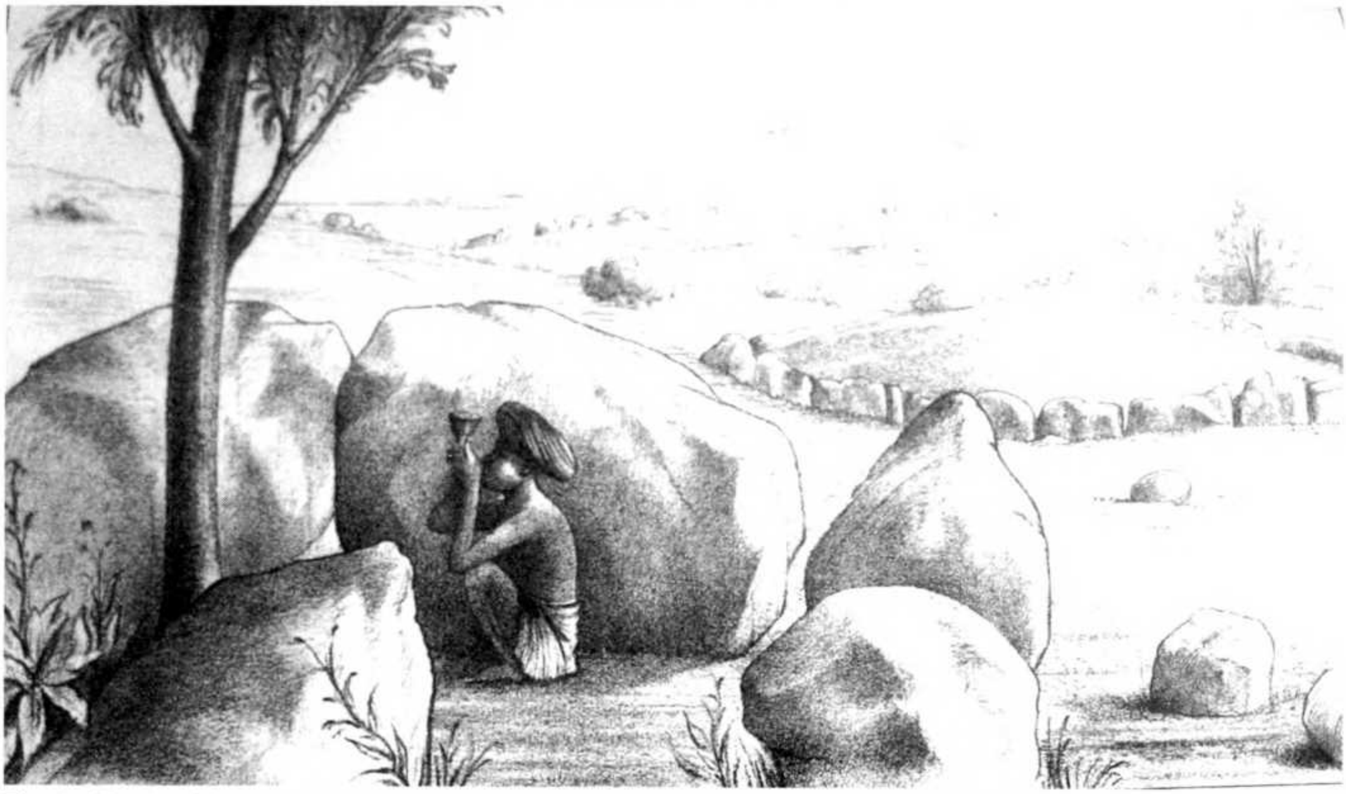

Fig. 1: Sketch of barrows (stone circles) near Nagpur (Reproduced from Rivett-Carnac 1879)

a kind of mosaic work, evidently to protect the ashes which were deposited in it. In the same cairn were found a spear-head, a piece of iron like a large knife or hatchet, nail, &c. At Takalghat there is a wide field for the antiquary. Indeed the country all round abounds in Scythian remains, but it would require a person with much leisure for their investigation. I am acquainted with about twenty localities where there are circles, and eight villages where there are kistavens in this district. (Hislop 1857: 671-72)

The exact year of excavation was not mentioned by Hislop in this letter, but perhaps this is the earliest known attempt in investigating the history of Vidarbha. What is important is the mention of Scythian stone-circles which indicates an understanding of this topic. Unfortunately Rev. Hislop drowned in the Bori river, in the vicinity of Takalaghat in 1863 at the age of 45.

J.H. Rivett-Carnac

John Henry Rivett-Carnac (1838-1923) was in the Bengal Civil Service. The first well documented exploration and excavation in the Vidarbha region dates back to 1867 and was undertaken by J.H.

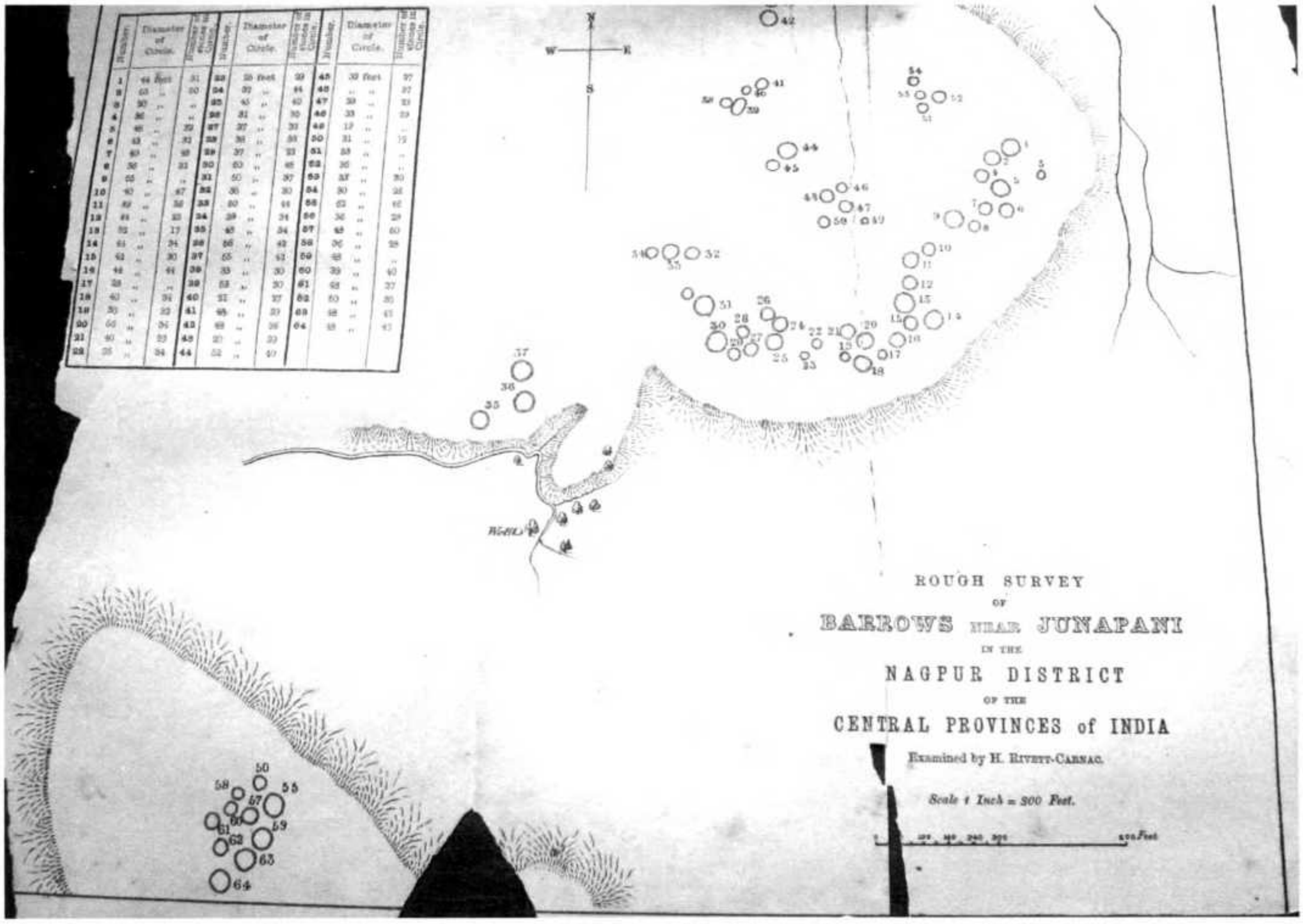

Fig. 2: Rough survey of stone circles near Junapani (Reproduced from Rivett-Carnac 1879)

Rivett-Carnac, Alfred Lyall, and Blanford at the site of Junapani (Nagpur district) (Fig. 1). A rough map based on this survey was prepared by Rivett-Carnac indicating locations of various barrows near Junapani (Fig. 2). The 'barrow' (a term used for 'stone-circle') at Junapani was excavated by them in January 1867. They recovered iron implements such as arrowheads, spearheads, axes, snaffle bits, iron razors, knives/daggers, etc. (Rivett-Carnac 1879). Others were also looking into the problem of stone circles (barrows). As per Rivett-Carnac (1879: 1-16), stone circles in the vicinity of Nagpur were explored by Colonel Glasfurd, Major G.G. Pearse, and J. J. Carey. Hanna and Henry Dangerfield worked on stone circles at Junapani.

George Godfrey Pearse

The year 1867 proved important, as after Rivett-Carnac's excavation in January, Major George Godfrey Pearse (1827-1905) of the Royal Artillery excavated at the site of Wurreegaon (one mile from Kamptee, Nagpur district) in July. Details of the excavation were published in *The Journal of the Ethnological Society of London* in 1869 (Pearse 1869: 207-217). This paper, is perhaps the best example of detailed description and excellent observation although no advanced technique was developed for the excavation of stone circles. During the excavation, he came across vessels of black and brown and black ware. Black vessels had covers with cone-like tops. He also found some husks of coconut shells. An interesting description of human remains is also given:

> 'On the 11th July 1867 (i.e. on the fifth day of excavating), at about 6 ½ feet depth, I found the remains of a man. [...] Part of skull, some teeth (one a molar one), are amongst the remains preserved. The body was 6 feet or 6 feet 1 inch long. The bones are of a large-skulled and large-boned person. [...] On the 12th July 1867 (that is on the sixth day of excavating) was found, on the same level as the first body, a second body of about the same size, parallel

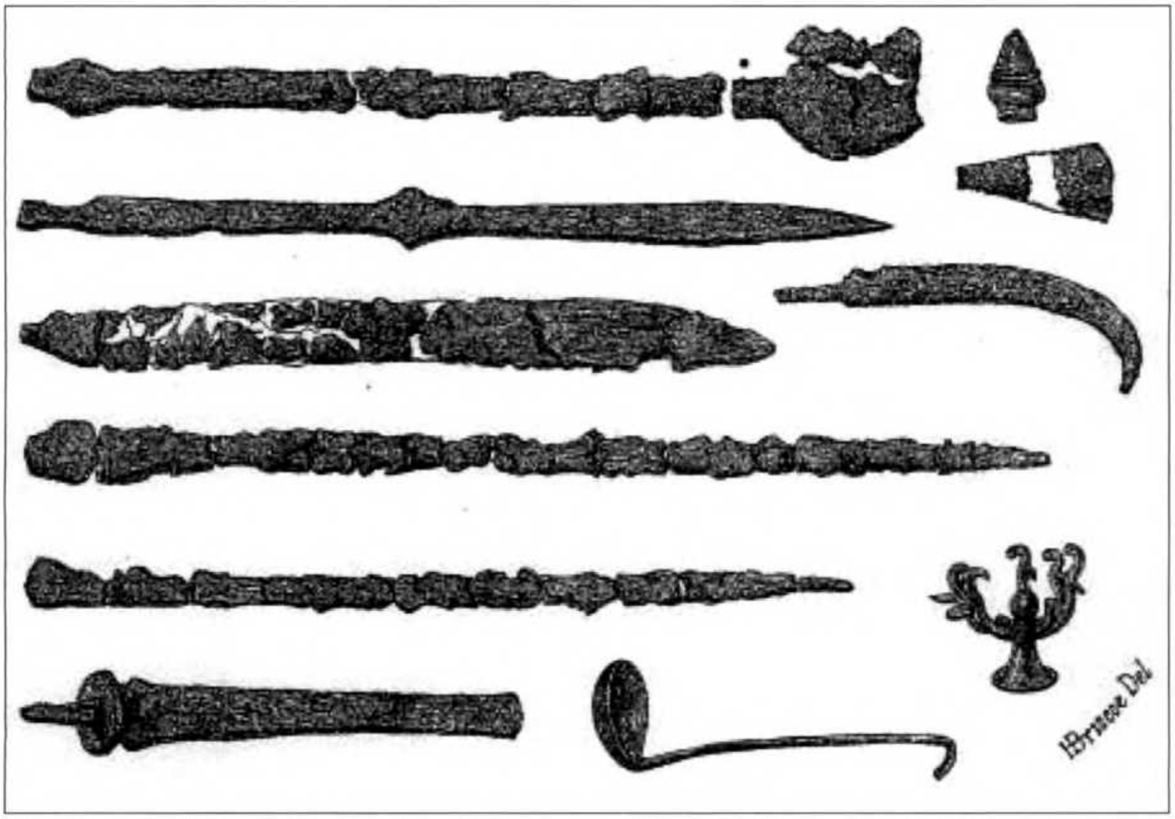

Fig. 3: Iron implements from the site of Wurreegaon (Kamptee, Nagpur district) (Reproduced from Pearse 1869)

to it and separated from it a yard or so (Pearse 1869: 211-212)'.

Other important antiquities reported are iron steel-tipped ploughshare-end, the cover of a copper vessel (having figures of geese, a snake and a bird), spoons, knives, spatula, a frying pan, ring of gold, a little copper ornament having figures of geese ornamenting it (lid?), etc. (Fig. 3 and 4).

More important was Pearse's conclusion on the author of the barrow; quoted below:

'Thus, I believe, they were neither Buddhist nor Hindoos, Greeks nor Christians. It seems probable they are of anterior date to 330 B.C., and possibly that they are of 1200 B.C.

It is very certain:-

They were civilized.

They were tall and strong.

They were very numerous to have raised such a monument (demanding much time and labour) over two of their number.

They made the best of steel.

They were agriculturists.

They ate wheaten cakes and fried food.

They burnt oil.

They possessed goldsmiths.

They rode horses.

They drove carriages or chariots.

They knew the use of the potter's wheel.

They could give fair representations of animals and birds.

They could smelt copper.

They were traders, the cocoa-nut requiring to be carried 350 miles in a direct line to them.

And, by the instruments and articles they have left behind them, they appear to have been early (if not the earliest) users of many of those of a household economical nature which are to be seen in a more or less modified form in general use now-a-days in India' (Pearse 1869: 215-216).

The conclusion is significant, since what Pearse observed 150 years ago, is still similar to what we know on many aspects of the megalithic culture. The implements recovered from Junapani and Kamptee excavations (Fig. 5) were also discussed by L. Leshnik in detail (1970: 498-511).

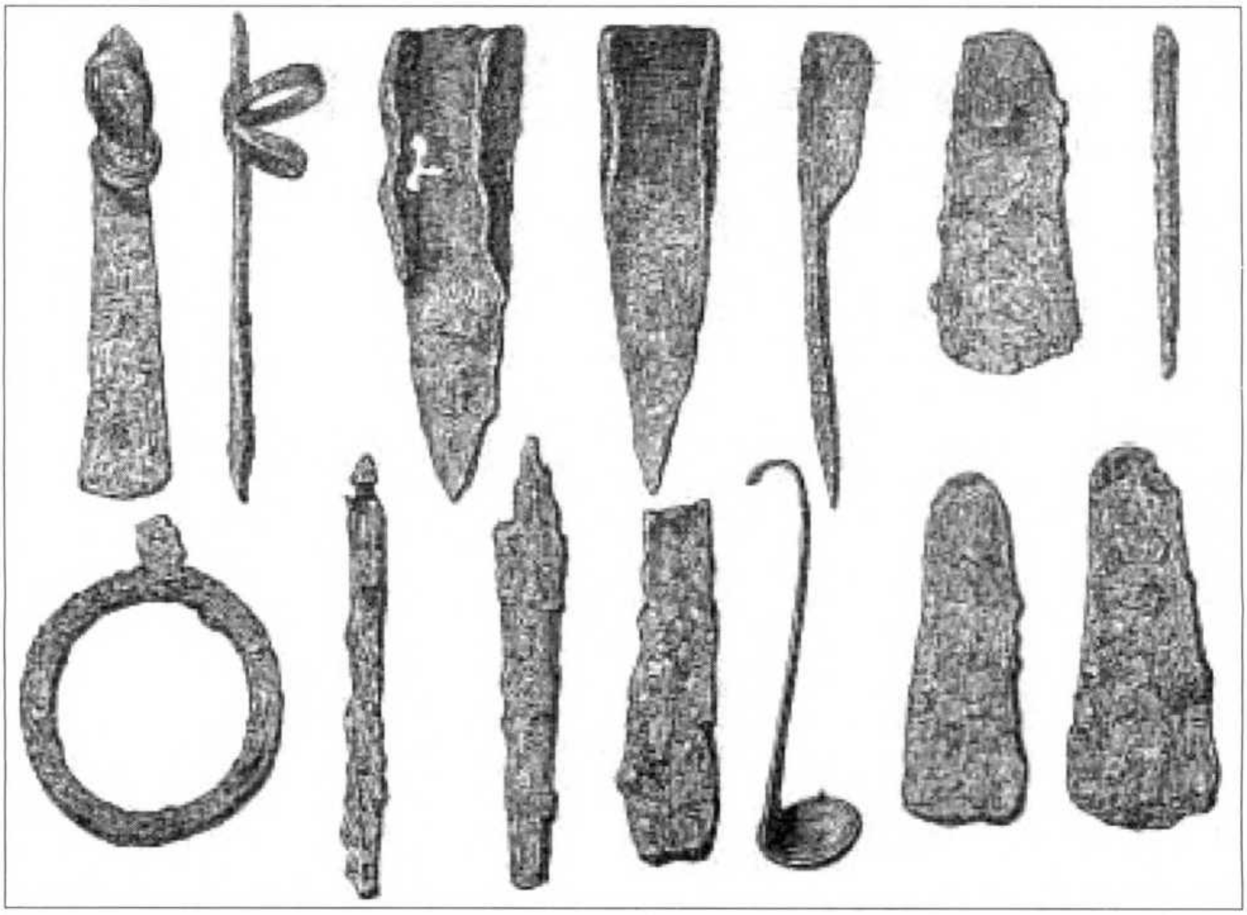

Fig. 4: Iron implements from the site of Wurreegaon (Kamptee, Nagpur district) (Reproduced from Pearse 1869)

J.J. Carey

J.J. Carey, Executive Engineer, Khangaon, excavated a few stone circles at Khaiwarra (modern Khairwada, also spelt as - Khywarree by Rivett-Carnac) 24 km west of Arvi in District Wardha, probably in 1869. Each stone circle was termed a mound by Carey, and around 150 such so called mounds were noticed by him. Some of his observations are very interesting to note:

'The stone circles lately found by me near the village of Khaiwarra, about 10 miles east of Arvi in the Wardah district, were opened by desire of Mr. Morris, chief Commissioner, Central Provinces. […] The mounds in every case were hollow at the top, making me think that a chamber would be found underneath, that the stones forming the ceiling had probably given away; but, on opening two, nothing was found to guarantee such an idea. […]

I commenced digging operation on the principal mound in the place, 40 x 43 in diameter, […] Nothing but loose stones and earth was removed, until about 15 inches from the surface broken red pottery began to show on the south side. At last some stiff leaden coloured clay was found, fast binding pieces of pottery, and on close examination large quantities of teeth were found, which evidently had been put into a *gurrah* and imbedded in this clay. These bones are, I believe, the back teeth of horses, in very good preservation. […]

[…] I saw a "find," and immediately jumped into the hole, and with the greatest care dug out of the clay, well cemented together, two copper bells, two round copper (in my opinion) ear-rings, and an iron-axe […] this and a few iron implements and a gold ring were the only things found. The excavation was carried down about 2.6 feet.

In the other we went down over three feet from the surface […] The only implement in good preservation was a kind of saucer for holding oil, which had a handle with a hook to hang by, and a

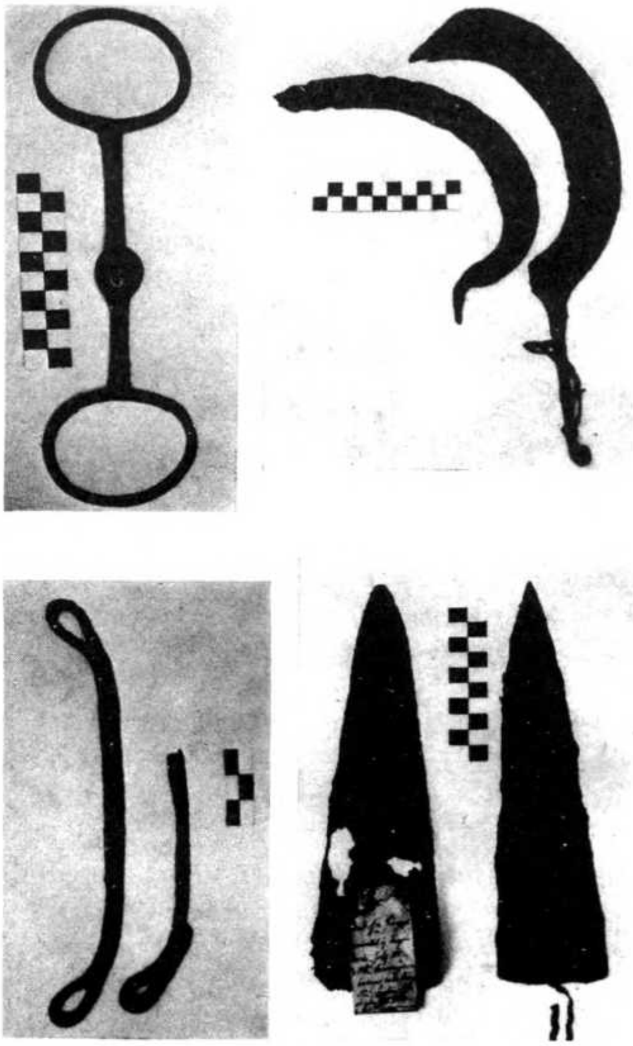

Fig. 5: Implements recovered from Junapani and Kamptee excavations (Reproduced from Leshnik 1970)

spiral spring, which must I think have been wound round a stick' (Carey 1871: 238-239).

Phase II. Period of Intensive Explorations (1870-1950)

Alexander Cunningham

Alexander Cunningham carried out an archaeological tour in 1873-74 and 74-75 covering the Central Provinces (Cunningham 1966, reprint). In the course of surveys he explored Chanda (modern Chandrapur district) and surrounding areas and reported various historical sites, such as Bhandak and its temple and cave complexes, caves at Dewalwâra, temples and other structural remains at Chanda, temples at Markandi, etc., (Cunningham 1966: 121-160). Interestingly Cunningham also recorded two cromlechs or dolmens at the site of Keljhar, near Chanda. Cunningham did not otherwise show any interest in megalithic structures during his campaigns, hence this reference is important (Cunningham 1966: 140-141).

Henry Cousens

During the years 1892-93-94, Henry Cousens collected data regarding monuments, ancient sites, temples of Central provinces and Berar (Cousens 1971, reprint). In this book, he mentioned various stone circle and menhir sites in Vidarbha as well, such as Borgaon, Digras, Ghorar and Kohali, Junapani, Nildoh, Takalghat, Wathora, Charmursi, Keljhar, Wagnak, Sironcha, Pipalgaon, Telota Khairi (1971: 3-24). His comments on stone circles are interesting:

> 'These circles are of great age. No one can now say exactly what they are but it is commonly believed that they mark the site of temporary encampments of the Gavalis, or pastoral tribes who wandered from place to place with their cattle. Others say that such places were formerly used for interring dead bodies. Sometime iron nails and tools are found beneath the stones. Possibly they are of Scythian origin' (Cousens 1971: 5).

J.D.M. Beglar

Joseph Daviditch Melik Beglar had training in Civil Engineering and was working with the Public Works Department as an Assistant Engineer. He worked as Cunningham's assistant in the Archaeological Department from 1871 to 1879 (Singh 2004: 135-136). During his association with this department he carried out surveys in various parts of India (Beglar and Carlleyle 1874, Beglar 1878a, 1878b). During exploration in the Central Province in 1873-74, Beglar showed an awareness of the need to learn about the 'Old Road'. He observed:

> 'The Old Road appears to have come from some point near Bhandak or Dewalwárá, supposed to be the ancient Kundilpur (I cannot speak with confidence on this point, not having examined the country west of Nágpur), through Deotek close past Palásgarh, past Banjári (a great mart for articles of traffic by pack animals), past Ámbágarh Chowki (which possesses a small fort of no interest, and probably not very old), past Bálod, Sorar, to Gowror, whence it branched

into two, one going *via* Kákér and Sehwá towards Ganjám, through the great fort of Jaugada, which contains one of Asoka's edicts; the other branch going past Dhamtari and Rájam, thence probably skirting the Mahanadi northwards past Savaripura, Savarinararan, & c., to Katak. The determination of these ancient lines of communications is of great importance; for my experience, little as it is, has shewn me that away from great lines of communications of ancient times few archaeological remains are to be met with; they are not spread about at random here and there in isolated spots, but *always* on the great old roads, and however isolated any particular remnant of antiquity may be at first sight, it will be found on close examination to be on some old line of road [...]'. (Beglar 1878a: 140)

Apart from describing the old road from Vidarbha to Orissa, Beglar also tried to identify the ancient Kundilpur (or Kundina) with Bhandak or Dewalwara with some uncertainty. Beglar's attempt must be recognized for at least attempting an identification of a historical site of Vidarbha. Later, the site was identified with modern Kaundinyapur in Amaravati district. An interesting incident is also reported by Beglar on problems he faced at Ramtek, Nagpur, when he was forbidden by a group of Brahmins, to enter temples and inspect them in person (Beglar 1878a: 111-112).

Other Efforts

Apart from stone circle investigations, the first extensive survey at the historic site of Mansar (45 km north-east of Nagpur) was carried out by T.A. Wellsted as early as 1933, which brought to light antiquarian, epigraphical and structural remains of the Vakataka period around Hidimba tekdi. To the east of this hillock, structural remains of the great monastery were noticed (information cited in IAR 1994-95: 55-57).

The historic antiquity of Mahurjhari (Mahurziri – as spelt by Hunter) was brought to light by G. Hunter, and first published in the *Annual of the Sharadasrama* of Yeotmal in 1933. G. Hunter had come across bricks having size of 16"-17" x 10"-11"x 3"- 3 ½". He reported a seal with a box-headed script of the Gupta-Vakataka period. He also published data on a carnelian seal with the letters reading '*apumada*' or '*apramada*', an intaglio in Vakataka characters, an exact replica of the Proto-Elamite seal in red sandstone, a seal in rock-crystal and a 'Naga' seal. He also reported finds of a Lajja-gauri plaque and beads, made of a variety of semi-precious stones (Hunter 1933: 30-35).

All theses attempts were amateur, basically unorganized and individually inspired without any institutional backing, except for J.D. Beglar (A. Cunningham's assistant) who carried out government sponsored surveys in the central provinces but failed to identify the potential of any site for further investigation.

Phase III. In Search of Historical Identities: Post-Independence (1950-1970)

During the post-independence period, the ASI became active in this region. In concurrence with earlier attempts, many Indian scholars continued to explore and excavate megalithic sites. These included N.R. Banerjee who explored the site of Mahajari (Mahurjhari) near Junapani (IAR 1958-59: 21) and B.K. Thapar who excavated the site of Junapani (IAR 1961-62: 32-34) and others.

After independence, the state department and universities (Nagpur University, Deccan College) emerged, outside the ASI's scope. Foremost among these was the department of AIHC and Archaeology of Nagpur University (established in 1955). Located in the heartland of Vidarbha, it became an obvious hub of archaeological activities in this and surrounding regions. The MSDAM also rose on a strong footing. The result of this development was the first full-fledged excavation in Vidarbha which was carried out by the MSDAM and Nagpur University.

The first excavation at a historical site after independence took place at Kaundinyapur in Vidarbha in the years 1962 and 1964 (Dikshit 1968), although the historical importance and potential of the site, was clear as early as 1933 (Deshpande 1933: 36-46). The site was chosen for excavation since it was mentioned in the *Mahabharata*, in connection with the Krishna and Rukmini story (Rukmini was the daughter of the Vidarbha king, Bhishmak). The place called Kundina (modern Kaundinyapur) is also mentioned in the story of Nala and Damayanti, who was the daughter of the Vidarbha king Bhima. Thus, the first excavation after independence in Vidarbha was perhaps carried out with the aim of revealing the authenticity of these epic stories.

The next excavation, at Paunar in 1967 (Deo and Dhavalikar 1968) was carried out by Nagpur University. The site was selected probably due to the assumption put forward first by K.N. Dikshit, and supported by V.V. Mirashi, that modern Paunar was the site of the ancient Pravarapur, capital of the Vakatakas. However, according to the excavators, 'there is no confirmatory evidence to show that Paunar was the ancient capital Pravarapura. The excavations were confined to a very small area and that to on the periphery of the ancient mound near the river' (Deo and Dhavalikar 1968: 202). Recently the site of Mansar has been identified as the ancient Pravarapura by J.P. Joshi and A.K. Sharma, as mentioned in Vakataka inscriptions (see Joshi and Sharma 2005).

The next important excavation at Pauni was carried out in the year 1969-70 (Deo and Joshi 1972) again by Nagpur University in collaboration with the ASI. Despite early notices on the antiquity of the site as early as 1897 by Henry Cousens (1971: 24), the site was selected for excavation only when a local newspaper reported that a few sculptures and a massive coping stone fragment bearing an inscription in Brahmi characters, were found near a locality termed Jagannath Tekdi (Deo and Joshi 1972: 1). This excavation was very productive as it exposed the first stupa structure of Vidarbha. Important features along with the stupa structure were noted such as railing, *pradakshina patha*, gateways, pillars, and *chhattravali*.

What is important in this period is an increased awareness at the regional level which in turn resulted in an increase in the number of excavations and explorations, which extensively aided in understanding regional chronological profiles.

Phase IV. Excavations of Iron Age Sites and the Contribution of S.B. Deo (1970's -1980's)

This phase saw a shift in focus towards excavations and explorations of Iron Age - Megalithic sites. The unique feature of the Vidarbha region lies in the large uniqueness of Megalithic circles and the iron and copper implements associated with these circles. Excavations at various megalithic sites, (burial and habitation), unearthed Vidarbha's very own culture different from that of South India in many respects. This culture is totally absent in the rest of Maharashtra. From the 1970's onwards various important Iron Age–Megalithic sites were excavated, such as Takalghat-Khapa, Mahurjhari, Arni, Khairwada, Boregaon, Naikund, Bhagimahari, Adam, Tharsa, Arambha, Shirkhanda, Bhawar, Pachkheri, etc. (see Table 1).

The Contribution of S.B. Deo

S.B. Deo (1923-1996) contributed immensely towards understanding the Vidarbha Megalithic culture. His interest in the Iron Age-Megalithic culture of this region led to a number of excavations in this area. He studied almost all aspects of the Megalithic culture like pottery, tool techniques, house plans, subsistence, authors of the culture, etc. He is credited for being the first to obtain ^{14}C date for the Vidarbha Megalithic habitation site, Takalaghat and for providing a specific time bracket which was lacking earlier (Deo 1969, 1970a, 1970b, 1973a, 1973b 1973c, 1973d, 1982).

In 1966 he was appointed as Professor and Head of the Department of Ancient Indian History Culture and Archaeology at Nagpur University and remained there for eight years. During this period he efficiently carried out excavations at Paunar (1967), Takalaghat-Khapa (1967-68), Pauni (1968-70), Mahurjhari (1971-72) and Bhokardan (1973-74). He joined Deccan College in 1974 as a professor of Proto-Indian and Ancient Indian History, and became the Director in 1978, retiring in the same capacity in 1985. Important excavations carried out during his tenure were at Ter (1974), Apegaon (1976-77), Naikund (1977-78, 79-80), Mahurjhari (1978-79), Boregaon (1980-81), Khairwada (1981-82), Bhagimohari (1983-84) and Raipur (1985). Reports of six sites were published.

Phase V. Iron Age Studies: Scientific Approaches and the Contribution of Deccan College (1980-2000)

Crucial changes in research strategies regarding Iron Age-Megalithic studies are noted during 1980-2000. This phase witnessed the use of intensive scientific methods to understand various aspects of this culture. This phase also coincided with the establishment of various laboratories at the Deccan College, a unique feature in India.

With respect to the archaeology of the Vidarbha region, these laboratories significantly contributed in the following fields: palaeoanthropological work

(Walimbe 1988, 1992), palaeobotanical work (Kajale 1989, 1994), ancient iron technology (Gogte 1980; Gogte *et al.* 1982; Gogte *et al.* 1984), chemical analysis of soil (Deotare 1984, Kshirsagar 1992), chemical analysis of pottery (Gogte and Kshirsagar 1992, 1996), XRD analysis for pottery (Gogte 1992), archaeozoology (Thomas 1992a, 1992b, 1993, 1995, 1996, Thomas *et al. in press*), and demography (Mohanty and Walimbe 1993, 1996).

This phase also saw extensive excavations at Early Historic site of Adam (Nagpur) by the ASI (IAR 1988-89, 89-90, 90-91, 91-92).

Phase VI. Multi-disciplinary Approaches: The Current Theme (2000 onwards)

The beginning of the new millennium saw new approaches in early historical archaeology resulting in important excavations by the Deccan College (Bramhapuri 2002, Paturda 2002, Mahurjhari 2003-05, Bhon 2003-2007, Kholapur 2008-09); Nagpur University (Dhamna Linga 2003-04, Vyahad 2006); and Nagpur University with the MSDAM (Bhandak 2007, Chandankheda 2010).

Conservation and Reconstruction

As a result of a collaborative project between Deccan College, Pune and the Indira Gandhi Rashtriya Manav Sangrahalay (Museum of Mankind), Bhopal, the Iron Age-Megalithic site of Mahurjhari in Vidarbha was excavated by a team led by R. Mohanty of the Deccan College and one of the megaliths was transported and displayed as an open-air exhibit in IGRMS campus at Bhopal (Fig. 6) (Mohanty 2006: 77-80).

Studies of Climate Change

A few attempts were made to understand climate change occurring during the early historic period. Deotare (2006: 517-526) attempted to study late Holocene climate change on the basis of archaeological evidence from the Purna basin. He used archaeological evidence from the excavated sites – Bhon (Pre-Satavahana and Satavahana 3rd-4th century BCE to 2nd century CE) and Paturda (Post-Gupta 5th to 9th century CE). The study of botanical remains from these sites yielded a high proportion of rice grains as well as rice husk (about 50%), wheat, *jowar*, green gram, grass pea, black gram, pigeon pea and common pea from Bhon. Cereals like *jowar* (about 30%), pulses like black gram, green gram, pea, etc. were recovered from Paturda. The presence of rice (50% of the total grains recovered) which requires water in abundance indicated a favorable climate. On the other hand, evidence from Paturda with marginal recovery of grains such as millets, pulses, indicated deterioration in agricultural practices due to an unfavorable climate (Deotare 2006: 517-526).

S. Sathe's doctoral research (2008) at Deccan College focused on a qualitative and quantitative analysis of palynomorphs and other evidence from sedimentology, mineral magnetics, chronology, and phytogeography, at the site of Mansar (district Nagpur, Historical site) from lake deposits. This approach was adopted to reconstruct past vegetation and environmental history, in the late Holocene period, particularly over the last 2000 years.

Study of State Formation Processes in Vidarbha

The author attempted to study the archaeo–historical profile of the Vidarbha region from the c. 6th century BCE to 5 - 6th century CE; in order to reconstruct the process of state formation (from early to mature state). The author's research, aims at understanding the phenomena of urbanization and deurbanization and related consequences as reflected in transformations in material culture and to critically examine literary data and corroborate this with available archaeological data; and finally to synthesize archaeo-historical evidence (Sawant 2006). The author has also dealt with various other facets of the Historical Archeology of Vidarbha (Sawant 2003, 2009, *in press* a, b, c).

Studies of Site Formation Processes in the Historical Context

V. Kathale (2009) at the Deccan College attempted to study site formation processes of historical sites (Bhon and Paturda in Buldhana district) in the Purna Basin by analyzing material remains with the help of chemical analysis (ph, organic carbon, phosphate, calcium carbonate etc.). She concludes, 'the chemical analysis of the samples taken from the different trenches on different mounds from Bhon show intense human activity on the Mound-I in the area of Trench B9 and D11 whereas Trench-D on Mound II shows less intense human activity. Similarly the areas of Stupa and Bandi (Brick manufacturing area) are the manufacturing areas where less human activity is reflected in low phosphate content being religious and production centers respectively. This is a clear supportive evidence of the hypothesis that the different activities of human leave different signatures in term of phosphate content for longer period of time unless and until it is physically removed.'(Kathale 2009: 188).

Cultural Sequence of Vidarbha

Excavations in Vidarbha have established the cultural sequence, which is summarized here.

Chalcolithic

Very few sites have Chalcolithic deposits, e.g. Tuljapur Garhi (Bopardikar 1996), Adam (IAR 1990-91, 1991-92), Arambha (IAR 1991-92), and Shirkanda (IAR 1991-92). Of these, Tuljapur Garhi, is the only site in the Vidarbha which yielded Malwa and Jorwe phases similar to the Deccan Chalcolithic (Bopardikar 1996). Excavations at Adam brought to light, for the first time, a period called the 'Vidarbha Chalcolithic'. According to the excavator, Period II of Adam is ascribed to the Vidarbha Chalcolithic as the ceramic industry did not correspond either in form or in description with any contemporary Chalcolithic cultures of the region adjoining Vidarbha (for ceramic details see IAR 1988-89: 50-62).

Iron Age-Megalithic Period

Most excavations were conducted at Iron Age-Megalithic sites, and these highlighted their economy, technology, pottery, house types, etc (for details see Deo 1982, Joshi 1993, Mohanty and Joshi 1996). Problems regarding authorship, reasoning and theoretical approaches behind megalithic practices, differences (if any) between burial sites, burial-habitation sites, and habitation sites; and many more issues still remain to be addressed. Important features of the Iron Age-Megalithic period of Vidarbha include the extensive exploitation and multiple uses of iron. The presence of horses and horse-ornaments is an important characteristic of Vidarbha's Iron Age-Megalithic tradition and provides additional information on riding skills. Excellent craftsmanship is seen in the use of metals like gold, iron and copper. Important sites are Takalghat-Khapa, Mahurjhari, Arni, Khairwada, Naikund, Bhagimahari, Adam, Tharsa, Arambha, Shirkhanda, Bhawar, Pachkheri, etc. (for details see Table 1).

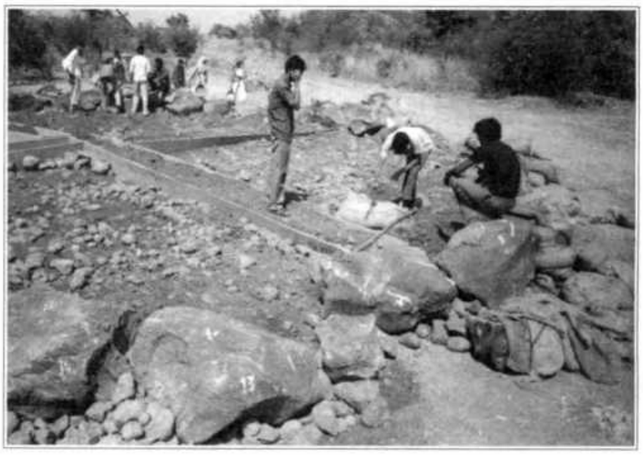

Fig. 6: Megalithic burial from Mahurjhari reconstructed and preserved at IGRMS, Bhopal (courtesy R.K. Mohanty, Deccan College Annual Report 2004-05)

Mauryan Period

Few sites have yielded habitation deposits of the Mauryan period. These include Adam (IAR 1988-89: 50-62; 1990-91: 45-50; 1991-92: 63-68; Nath 1992a: 69-79), Arambha (IAR 1991-92: 73-74), Arni (IAR 1978-79: 71-72; 1984-85: 55-56), Bhawar (IAR 1992-93: 55-62), Bramhapuri (Sawant 2003, 2006), Kaundinyapur (Dikshit 1968), Mansar (Joshi and Sharma 2005: 1-16), Pachkheri (IAR 1991-92: 64-73), and Pauni (Deo and Joshi 1972, Nath 1998). Some coins which were assigned to rulers such as Chandragupta, Bindusara and Asoka of the Maurya dynasty are reported from Vidarbha (see Gupta 1963). Important punch-marked coin hoards are reported from Bhandara (1878), Malegaon (1921-22), Mangrul (1923), Umrer (see Gupta 1955) and Salebhatti (1933) (Jain 1957). Apart from these hoards, a few coin specimens, assigned to the Mauryan period, are also reported from Nevari (Dikshit 1964: 91-95), Kaundinyapur (Dikshit 1968: 136), Mana (Kothalakar 1992: 24-28), Hinganghat (Allan 1936: lii, 56; Durga Prasad 1934: Pl. 16 – Sr. no. 85, Pl. 21 – Sr. no. 142), and Pauni (Gupta 1971: 107- 108).

Apart from the Mauryan punch-marked coins, the Vidarbha region also yielded local varieties which are assigned to various *janapadas* such as Vidarbha, Andhra, Asmaka, Chedi (see for details - Rajgor 2001, type no. 494; Sawant 2003: 12; Kulkarni 2004a: 40, Kulkarni 2005: 19-36; Ramteke 2006: 68-87).

A very important epigraphic record of the Mauryan period was discovered at Deotek, a small village in Chandrapur district (discussed later in detail).

Pre-Satavahana Period

A shorter chronology (propounded by A.M. Shastri) is inclined to date the Satavahana rule to around the middle of the first century BCE, thus creating an interval of several centuries between the termination of the Mauryan power and the commencement of the Satavahana rule. A fairly large number of uninscribed cast and die-struck specie in cheap metals like copper, potin and lead were reported from Adam, Kaundinyapur, Pauni, Bhokardan, Nasik, Brahmpuri (Kolhapur), Kotalingala, amongst others. These are termed as Pre-Satavahana issues (Shastri 1982: 1-16; 2002: 64). Archaeological remains of the Pre-Satavahana period is well represented at two sites – Adam (IAR 1990-91: 45-50; 1991-92: 63-68) and Bhon (Deotare 2007; Deotare *et al.* 2007; Sawant 2006, Shete 2009). Both sites have unearthed large scale structural activities such as stupas, brick wells and ring wells and residential complexes along with other antiquities. As far as earlier excavations are concerned, the Pre-Satavahana period may have been confused with the Mauryan or Satavahan periods; as this phase was not clear. The coins of Pre-Satavahana rulers like Bhadra, Mitra (Nath 1990a: 48-57), Sebak (Mirashi 1945: 95; Thakur 2006: 2) and some unknown provincial ruler from Bhon (Sawant 2006) are reported from Vidarbha (see also Jha 2004a and 2004b). In addition, very recently, city issues of *Bhadravati* have been reported from Bhadravati, Chandrapur district (Kulkarni 2004b; Jha and Varma 2004; Gupta 2005).

Satavahana Period

The Satavahanas along with their contemporaries, namely, the Kshatrapas (Mirashi 1981; Shastri 2002) and Maharathis (Mangalam 1999, 2002a, 2002b) played an important role in the history of Vidarbha. Sites in Vidarbha which have yielded Satavahana deposits include Adam (IAR 1990-91: 45-50; 1991-92: 63-68) (Nath 1995: 149-171), Arambha (Nath 1992a: 69-74), Arni (IAR 1978-79: 71-72; 1984-85: 55-56), Bhawar (IAR 1992-93: 55-62), Bramhapuri (Walimbe 2003: 39-40; Sawant 2006), Kaundinyapur (Dikshit 1968: 29), Khairwada (IAR 1981-82: 51), Mandhal (Shastri 1978: 143), Mansar (Joshi and Sharma 2000: 127-131; 2005: 1-26), Pachkheri (IAR 1992-93: 64-73), Paunar (Deo and Dhavalikar 1967), Pauni (Deo and Joshi 1972; Nath 1998), and Ramtola (IAR 1969-70: 20).

As far as epigraphic records are concerned, two inscriptions are of importance, both from the site of Pauni. In 1935, a stone inscription was incised on a massive slab discovered at Pauni, (Mirashi 1942: 11-14; Deo and Joshi 1972: 9). The characters in inscriptions belong to the early Brahmi alphabets and a Prakrit language. V.V. Mirashi (1942: 11) assigned this inscription to the beginning of the Christian era. The inscription records the dedication of a slab with foot prints (*pajugapati*) by Bhagadatta (*Bhagadata*), the king of the Bhara clan. It is not known whether this clan was identical with the Bharasivas whose glorious achievements are recorded in the Vakataka inscriptions. In 1964 a pillar inscription of three lines in early Brahmi characters of the 2nd century CE and Prakrit language, was discovered during farming at Pauni. The object of the inscription was to record that the sculptured pillar (*chhaya-khambho*) was in the memory of Mahakshatrapa Kumara Rupiamma (Mirashi 1968c: 201-203).

The most common motif on Satavahana coins from Vidarbha is an elephant on the obverse and the Ujjain symbol on the reverse. These are noted on coins of Satavahana or Sadavahana (copper), Vasisthiputra Pulumavi (copper/lead), Vasisthiputra Satakarni (copper/lead), Siva Sri Pulumavi (lead), Siva Skanda Satakarni (lead), Gautamiputra Yajna Sri Satakarni (copper/potin/lead), Vijay Satakarni (elephant), Saka Satakarni (?), Karna Satakarni, Kumbha Satakarni (potin) (see Jha and Verma 2005; Mirashi 1961: 336-337; Sarma 1980). The Laksmi type coin was reported from Kaundinyapur, attributed to Siri Satakarni (Dikshit 1968: 137). Some coins have a legend '*Satavahana*' or '*Sadavahana*'. Recent excavations at Bhon yielded a few inscribed coins, one of which lists the name of the issuer which reads as- '*Sadavahana*' (Sawant 2006: 132). Another type has a bold taurine, Ujjain symbol with a pellet inside and a legend '*no Siri Satavaha..*' (also of Siri Sati and Satakarni) on the obverse and a tree with leaves on the reverse (potin/bronze) (see Jha and Verma 2005). Two major hoards of Satavahana coins are recorded from Vidarbha, one from Chanda (Chandrapur district) (Rapson 1908: 21, 42, 48) and the other from Tarhala (Akola District) (Mirashi 1940: 83-94). Similarly, Kshatrapa coins were reported from various sites. Coins of Damajadasri III, Bhartadaman, Visvasena, Rudrasena III, Yasodaman, Rudrasimha II are reported from Akot, Karanja (Akola district), Washim, Bhatkuli (Amaravati district), Adam

(Nagpur district), and Paunar (Wardha district) (see Jha & Rajgor 1994; IAR 1962-63: 14; IAR 1987-88: 85; Mirashi 1960: 113-117, 1965: 94-96, 1968a: 92-95, 1971: 117-119, 1975: 152-153; Shastri 1974: 111-113, 1975: 154-157, 1979: 20-22). The most common type of coin displays the bust of a king on the obverse and on the reverse, the hill symbol in the centre with a wavy horizontal line signifying a river below, a crescent on the left and a star on the right near the top with legends on both sides (see Jha and Rajgor 1994).

Vakataka Period

The Vakatakas started ruling in Vidarbha and adjoining regions around the end of the third century CE and continued to rule upto the close of the 5th century CE (see Mirashi 1957, 1963; Shastri 1992, 1997). Sites such as Arambha (IAR 1991-92: 73-74; Nath 1992: 69-74), Arni (IAR 1984-85: 55-56), Hamalapuri (Sali 1998: 9), Kaundinyapur (Dikshit 1968), Mahurjhari (Hunter 1933: 30-35; Mohanty 2002: 45-47), Mandhal (Shastri 1978: 142-174), Mansar (IAR 1994-95: 55-57; Joshi and Sharma 2000: 127-131; Bakker 2002: 1-24), Mulchera (IAR 1988-89: 49), Nagara (IAR 1979-80: 50; Jamkhedkar 1983: 25-36), Paunar (Deo and Dhavalikar 1967), Pauni (Nath 1998: 9), Ramtek (Jamkhedkar 1983: 25-36), Shirkhanda (Sali 1998: 10), Tharsa (IAR 1989-90: 66-68), Vivekanandpur (Sali 1998: 9), Washim (Sali 1998:10-12) have yielded Vakataka deposits. Apart from this, the major source of information on the Vakataka period, comes from copper plates and stone inscriptions (Mirashi 1963; Shastri 1997). Though the Vakatakas were one of the important dynasties of the south, it is surprising that their coinage came to light very late as compared to their other accomplishments. It was assumed by some scholars that the Vakatakas did not issue any coins, but allowed coins of other rulers to circulate in their territory. This assumption was proved wrong in the light of new discoveries on Vakataka coinage (Shastri 1997: 136-146, Kulkarni 2003: 65-80, Meshram and Gajbhiye 2008: 65-67; for counter view see Goyal 2007: 1-15).

One of the important contributions of the Vakataka period is the development of Brahmanical iconography, which is reflected in beautiful sculptures (Fig. 7) and temple structures. Temple remains ascribed to the Vakatakas were unearthed at Paunar, Mandhal (3 brick shrines), and Ramtek (stone shrine) (district: Nagpur) and Nagra (one brick shrine) (district: Bhandara). Mandhal shrines are the earliest examples of Vakataka architecture dated to c. 300-600 CE (Jamkhedkar 1988: 59-72; Bakker 1982, 2002). The history of the Vakatakas remains incomplete without a reference to Ajanta. The Ajanta caves have always been regarded as a synthesis of religion and art. According to Walter Spink (1992: 177- 202), the Vakataka king Harisena, who ruled from 460 CE to 477 CE, was fundamentally responsible for the development of Ajanta (Gupte and Mahajan 1962; Yazadani 1983; Spink 1972, 1981, 1992; Dhavalikar 1973). Most early historical sites in Vidarbha were deserted by the end of the Vakataka period, leaving a gap till the medieval period. Sites such as Adam, Arni, Bhon, Bhawar, Kaundinyapur, Khairwada, Mahurjhari, Mandhal, Pauni, Pachkheri, Shirkhanda, and Tharsa were occupied upto the Satavahana or the Vakataka periods but were deserted after that (see Sawant 2006).

Contribution to Buddhist History

On the basis of available archaeological evidence the spread of Buddhism in Vidarbha, can be dated to the Mauryan period, especially during Asoka's reign. Excavations at Pauni (Bhandara district) (Deo and Joshi 1972), Adam (Nagpur district) (Nath 1989: 97), and Bhon (Buldana district) (Deotare *et al.* 2007) (Fig. 8) unearthed evidence of *stupas*. New discoveries in the form of Buddhist sculptures or rock-cut caves are also reported (IAR 1994-95: 58; Meshram 1996). The role of Buddhism in Vidarbha was studied by S.B. Deo (1973b) and later more elaborately by P. Meshram of Nagpur University (Meshram 1993, 1994, 1996; Meshram *et al.* 2005).

Deotek, a village in Chandrapur district, about 50 miles southeast of Nagpur, yielded a large inscribed slab bearing two epigraphs, first published by J.D. Begler (1878a: 124-125). He noted: 'The first inscription consists of four lines, running longitudinally, [...] The characters are of the kind known as those of the Asoka edicts [...] The second inscription is in five lines running across the stone [...] this is in the early Gupta characters [...]' (Begler 1878: 124). Later, V.V. Mirashi published details of both inscriptions (Mirashi 1968b). One inscription dates to Asoka and the other to the Vakatakas. The inscription of the Asokan period records the command of some lord (*Sami*) who prohibits the capture and slaughter (evidently of some animals in certain seasons as in Asoka's 5th pillar edict, or throughout the year) and declares a punishment for those who dared disobey. The third line mentions executive officers (*amacha = amatyah*) whose duty may have been to enforce these orders. The last line contains the date 14, denoting probably the regnal year in which the record was incised. In some of his inscriptions (e.g. Rupnath Rock Inscription), Asoka orders his officers to get his edicts engraved on stone pillars, rocks and stone slabs throughout districts in their charge. The Deotek inscription probably is the only instance of its kind (Mirashi 1968b: 125-134). With the exception of the Sopara inscription, this is the only inscription of the Asokan period from Maharashtra. What is important in this inscription is the order of prohibition of capture and slaughter of animals which was the theme of Asokan edicts.

The site of Mansar, Nagpur was excavated by A.K. Sharma (former Superintending Archaeologist, ASI) and J.P. Joshi (former DG, ASI) since 1997-98 (IAR 1997-98). Initially the excavators declared that the site was of Buddhist importance with Stupa and viharas. The on-site museum and research centre was entitled, 'The Bodhisattva Nagarjuna Memorial Research Centre and Museum'. It is now clear that it is an important site of the Vakataka period and the excavator has identified it with ancient 'Pravarapura' (capital of Vakatakas) (Joshi and Sharma 2005: 1-26).

Conclusion

From the very beginning of archaeological research in Vidarbha, great emphasis was given to Megalithic sites. Archaeologists attempted to stress the unique nature of individual megalithic sites. However, no one attempted to examine their importance in a regional perspective and to study the Iron Age to Early Historic transition. What is important to note, is that most excavated sites in Vidarbha belong to the Iron Age-Megalithic period, although very few attempts were made to explain the phenomena of megaliths with a problem-oriented approach.

Few attempts were made to reconstruct the history of Vidarbha combining archaeology, historical information and literature. Such a holistic approach is necessary to understand cultural transformation processes, namely, the Early Iron Age and Early Historic transformations and subsequent stages in the political, social, religious and economical development in Vidarbha.

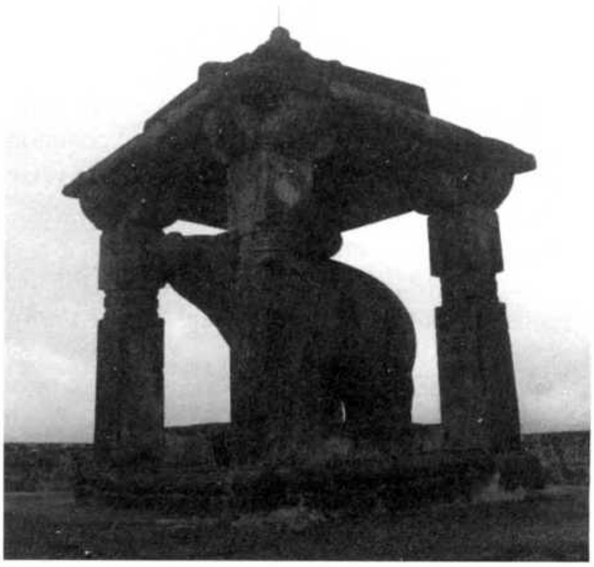

Fig. 7: Varah from Ramtek, Nagpur

Historical sites were often neglected at the cost of studying Iron Age sites. As a result, very few historical sites were excavated as compared with Megalithic sites. This is probably the reason why the Early Historic period of Vidarbha remained ignored. Today favorable changes are taking place, as various organizations such as the Deccan College, Nagpur University, the ASI, and the MSDAM, are excavating historical sites which will prove information in developing rational and logical explanations on cultural processes in Vidarbha.

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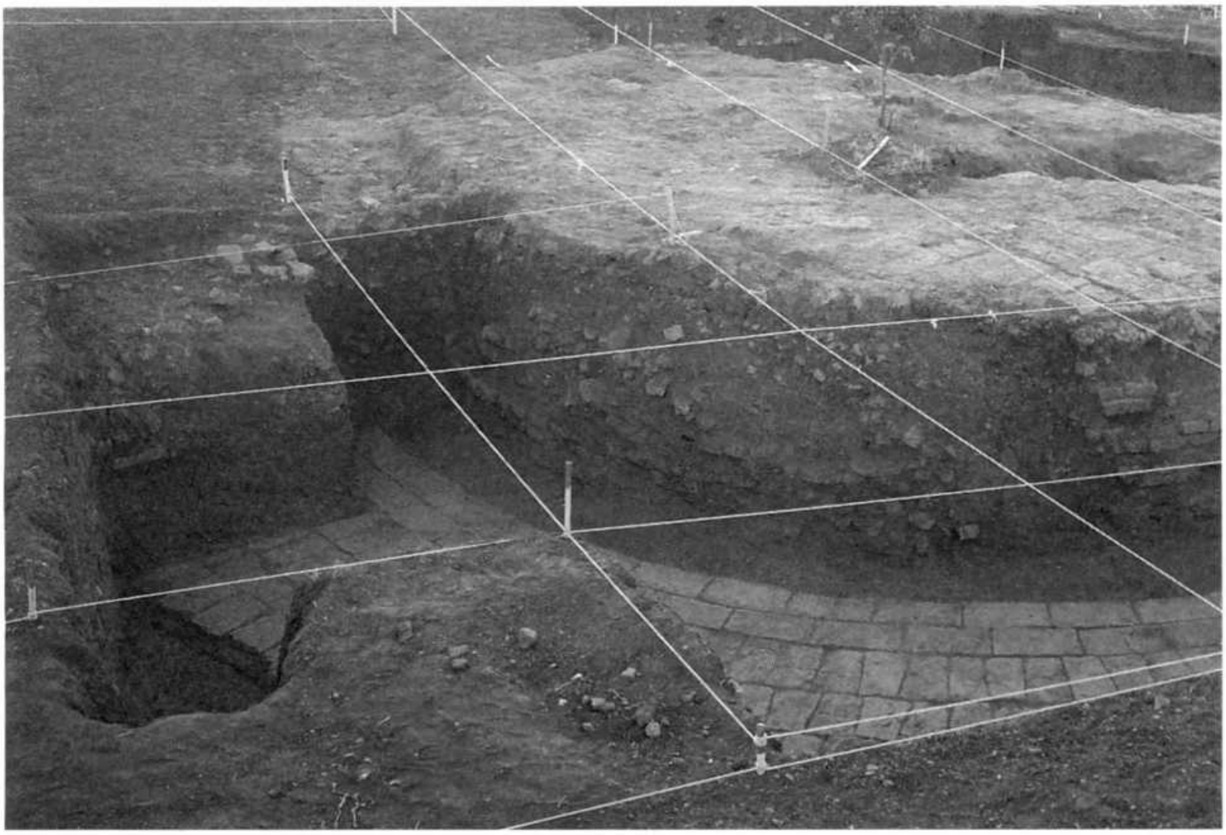

Fig. 8: Stupa structure at Bhon (Courtesy B.C. Deotare)

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A Note on Two Protohistoric Sites in Deodurga Taluk, District Raichur, Karnataka

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Abstract

This article reports new discoveries of rock bruisings, mainly of the Chalcolithic period, in Maladkal, and megalithic menhirs at Hireboodur, Raichur district, Karnataka.

Introduction

Raichur district of Karnataka has many Protohistoric sites. Capt. Munn (1934: 121-135), the chief geologist of the then Hyderabad State was the first to describe archaeological sites known mainly in Lingasagur, Koppal and Gangavathi taluks of the district. The latter two taluks are now included in the newly formed Koppal District. Allchin (1960: 1-148), published findings of his excavations at Piklihal. The bruisings at Kalllur and Billamarayana gudda were discovered and described briefly by others in the former Hyderabad State (Sundara 1976: 97 -103). Sundara (1976, 1987: 1-31) and Shadakhsharaiah (1990: 245 - 253) carried out further studies. Later Sundara (1990) wrote a good account on prehistoric art in Karnataka. There are also ancient copper mines in Kallur and Gaudur-Machnuin; the region under study. Within a distance of about 30-40 km from Kallur, while in the process of exploring material relating to the Lingayat *Vachanakaras* of 12th century, the author discovered two Protohistoric sites, at Maladakal and Hireboodur, in Deodurg taluk.

Bruisings at Maladkal

The rock bruisings are in the village, at a distance of about 35 km west-northwest of Raichur and about 8 km south of the Raichur-Deodurg main road (Fig. 1). The bruisings are found on boulders of a granodiorite hill (Fig. 2), with the peak reaching a height of 485 m ASL. The village lies at the foot of the hill.

Granodiorite is a fine-grained hard rock, owing to which the lines of the bruisings are sharp. On the other hand, at Billamarrayangudda where boulders are of coarse gained granite, the lines are not sharp. The boulders, brownish in colour, have many fractures. The figures depicted are mainly deer, a cheetah, bulls, and humans. These figures are engraved on different boulders close to each other.

A cheetah in the midst of deer (Fig. 3) reminds us of paintings on the well- known Chalcolithic vase from Daimabad (Maharashtra) and Central India. The figure of the cheetah is very interesting. Its long tail is stretched backward and curls towards the end, while the head is somewhat triangular. Around this cheetah are a few small and large deer and a human figure in a running posture. It is interesting to note that the whole composition belongs to one phase. A human riding an animal is present (Fig. 4). The animal's tail is trifurcated at the end, and it resembles a horse. However, the trifurcated tail is a common feature in deer in Chalcolithic and early Iron Age Megalithic sites found in rock shelters (No. 1 to 4) at Hirebenkal and at Halkundi (Sundara 1974 : 21-23, 1985: 160-167). A bull in outline is depicted with its head turned backwards (Fig. 5). This figure is comparable in style to the one on a Neolithic axe from Hasoodi near Shimoga reported by Sundara (2006: 3 - 5). A humped bull with straight horns with slight curvature is clearly depicted in another place. Other figures riding the bull cannot be identified because of recent overlapping bruisings. There are other depictions of the bull with a hump, here and elsewhere. A bull with hump is depicted at another location. Here, the legs of the animal are long and slender (Fig. 6), and the curving of the tail is rather exaggerated.

The presence of these bruisings on boulders clearly suggests the existence of a human habitation site nearby. A rivulet, located nearby although dry in summer, could have been a water source. The existence of a modern village at the foothill makes it difficult to differentiate recent from ancient habitation. Only after further exploration and systematic excavations would it be possible to ascertain the nature of habitation.

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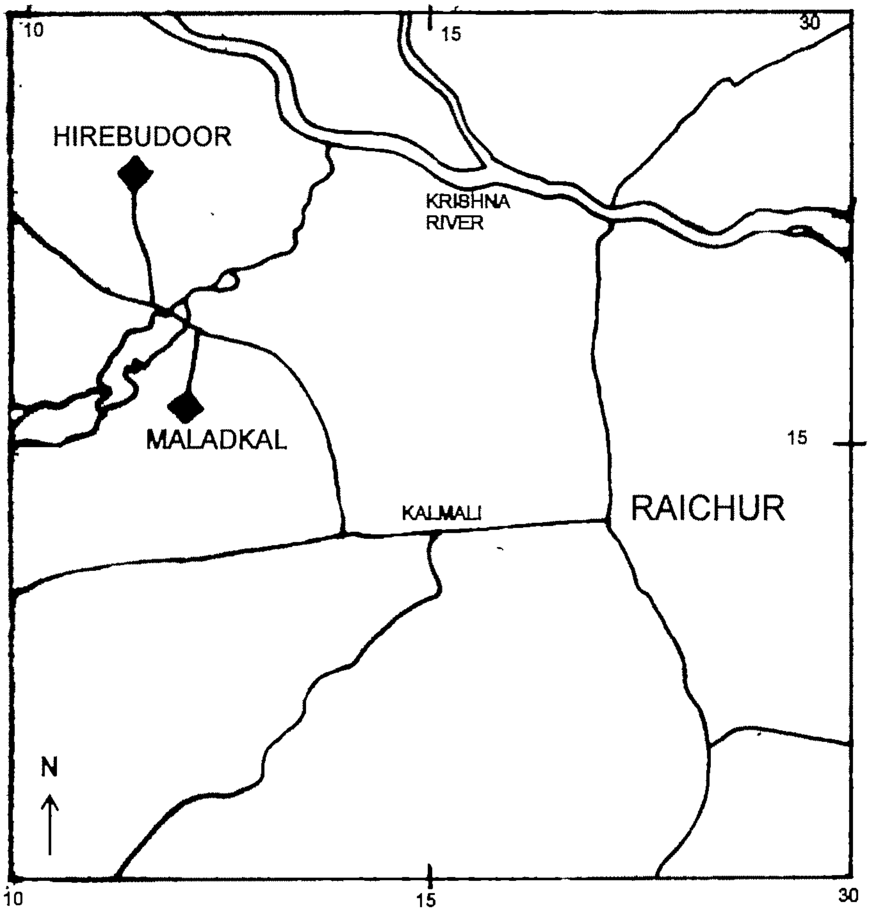

Fig. 1: Location map

Menhirs at Hireboodur

Hirebudoor is located at a distance of about 45 km northwest of Raichur and at a distance of about 15 km north of the Raichur–Deodurg main road (Fig. 1).

Hirebudoor means an older village or a place full of ashes. The name itself is suggestive of the existence of an ancient habitation of perhaps the Protohistoric period. In front of the veterinary hospital in the locality (Fig. 7) two tall menhirs (approximately 2.40 m high) were noted. Two more menhirs are only partially preserved owing to vandalism. These boulders are of coarse-grained granite, light grey in colour with biotite mica crystals visible. One of the tall menhirs is of coarse-grained pink granite. It is also in its natural form without any chiseling. The width is almost the same from top to bottom. One of the smaller menhirs, somewhat rounded, is of pink granite. Field examination clearly indicates that these boulders were brought from two different sources and were erected in a row.

It is to be noted that local people call these menhirs *`baananti kallu'* in the Kannada language which means puerperal stones and worship them when a pregnant women is not able to give birth normally. It is believed that after worshipping these stones pregnant woman deliver babies without any problem. Menhirs in Nilskal, Baise (Hosangar Taluk) and Murumba (Shimoga district) were associated with human burials (Sundara 2004). It may be recalled that stone alignments (menhirs) at Maski (Thapar 1957: 35-37), and Piklihal (Allchin 1960), both in Lingasugur taluk, Raichur district, were not associated with human burials. Therefore it is difficult to associate the menhirs at Hirebudoor with human burials.

Conclusions

In view of the above discoveries, the following conclusions are drawn. The Maladkal bruisings are comparable to those found elsewhere in the state and belong to the Chalcolithic to Iron Age-Megalithic

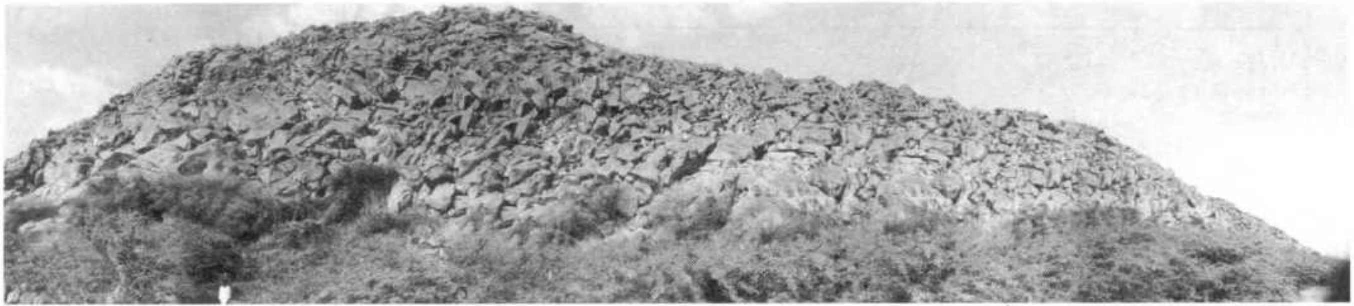

Fig. 2: Granodiorite hill

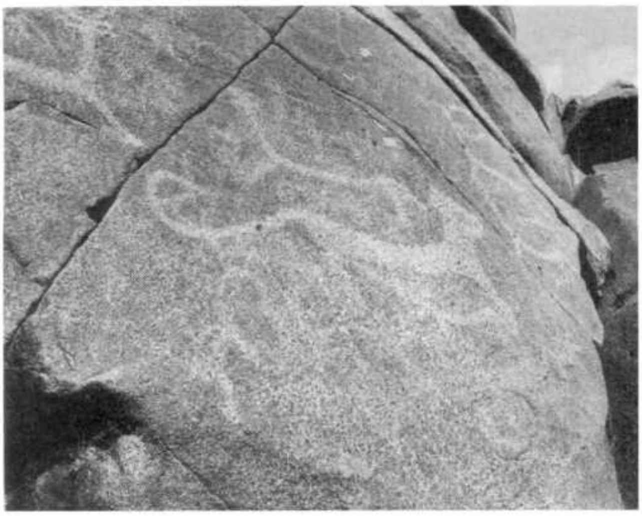

Fig. 3: Cheetah and deer

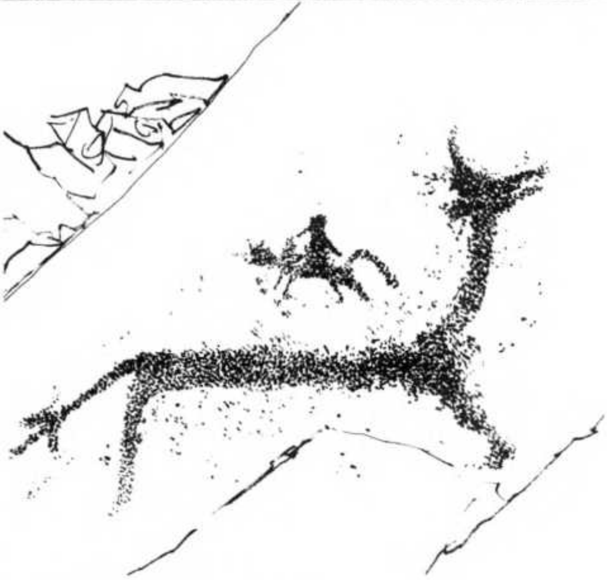

Fig. 4: Horse rider and a deer

period. Ancient habitation related to menhirs needs to be identified around the hill or near the *nallah*. The four menhirs, obviously a surviving part of some large site of menhirs, found in Hirebudoor, belong to the Protohistoric period. The source of these stone boulders used as menhirs needs to be looked for, as there is no hillock near the village.

There are two categories of menhirs found in South India from the point of view of the associated culture and the patterns of their lay-out. The menhirs in the southwestern part of Karnataka and adjacent Kerala are sepulchral (Sundara 1979: 97-101). These menhirs are generally thick slab-like huge stones. Menhirs of the second category are boulders and are non-sepulchral. These are aligned in two different patterns, termed as `Squares' and `Diagonals' (Allchin 1960). In the light of the findings of Sundara (2004: 242-46) at Baise, the menhirs of Hireboudoor seem to belong to the first category. If the present suggestion is correct, this will be the northern most extension of this particular tradition in the zone where the second tradition was a dominant practice.

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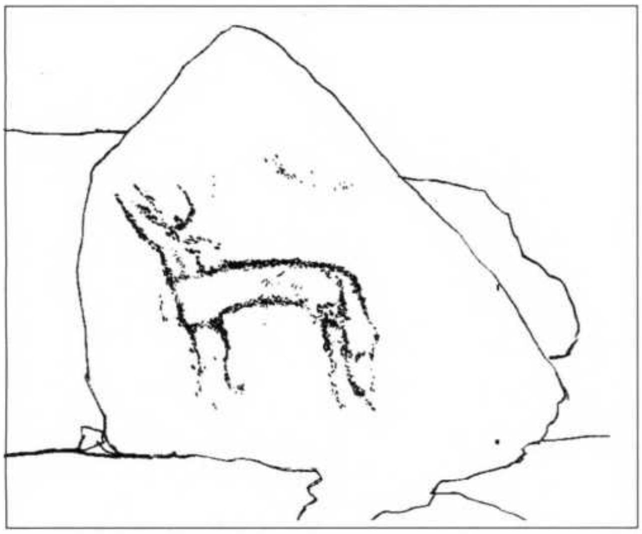

Fig. 5: A bull facing backwards

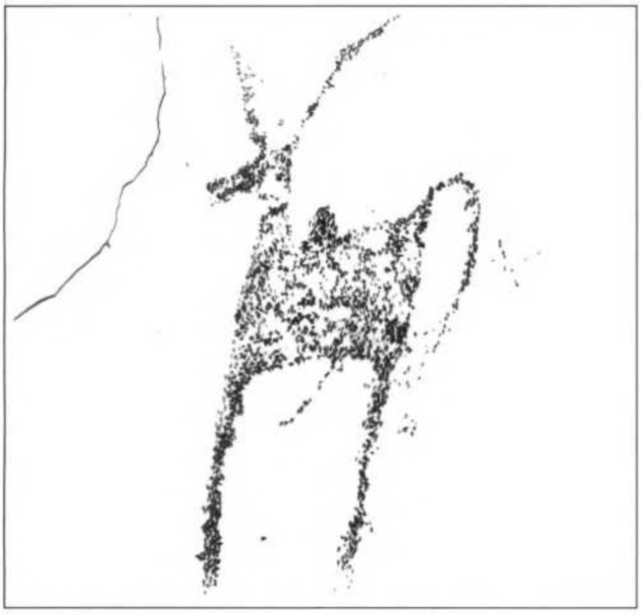

Fig. 6: humped bull with long legs

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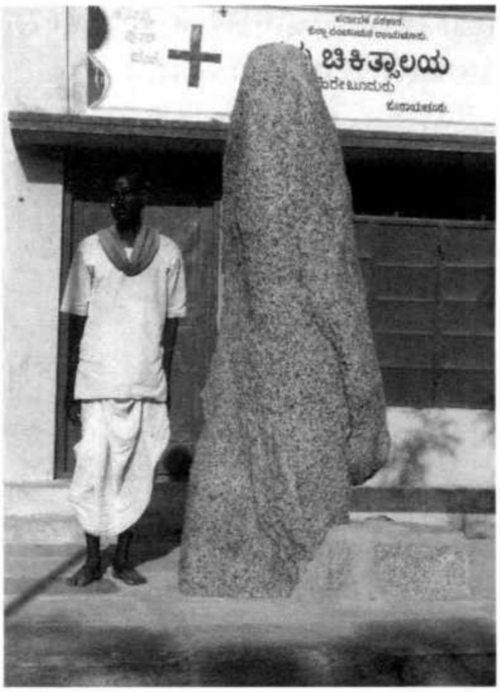

Fig. 7: Menhirs in front of the veterinary hospital at Hirebudoor

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Geophysical Investigations of a Sand Deposit at Kelshi, Ratnagiri District, Maharashtra

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Abstract

Kelshi ia a coastal village, located on the southern bank of the Bharja river in Dapoli taluka of Ratnagiri district. Artefacts collected from the site showed the existence of human habitation for at least seven centuries. The habitation site is covered by +20 m thick sand deposit. Geophysical investigations for delineation of subsurface stratigraphy and buried artefacts were carried out. Seismic Refraction, Electrical Resistivity Imaging, Ground Penetrating Radar and Differential Global Positioning Surveys were conducted to observe the nature of strata and to uncover buried artefacts. The investigations were fruitful in understanding the depositional environment of the sand deposit.

Introduction

Kelshi (17° 55' 50"N; 73° 03' 10" E), a coastal village in Dapoli taluka of Ratnagiri district (Fig. 1) is located on the southern side of the Bharja river. All along the coast, habitation deposits occur, and are covered by sands of up to +20 m in thickness. The sand deposit at Kelshi is S-shaped (Fig. 2) and is spread over an area of about 570 m^2. Its average height is 18 m and on the northern side the highest point is 32.4 m. The site is located at the mouth of a small stream termed the Bharja River. The western face of the sand deposit has a gentle slope while the leeward face is steep. The eastern slope merges with a flat terrace on the landward side. The sand deposit is isolated from the modern dune and beach by a tidal channel. There is a small beach at Kelshi located between two rocky headlands. On the northern side lies the Dighi Hill (190 m amsl). The sand deposit is 150 m away from the beach.

The uppermost part of about 15 cm comprises loose sand. There are abundant shells and fish bones on the surface of the sand deposit. At the base, the sand deposit is very compact and has several burrows. The lowermost portion is under the direct influence of present day high tide and is characterized by deposition of coarse and fine sands. The middle and upper portion of the deposit shows dominance of fine sand. The northernmost part of the deposit has mainly fine sand. Twenty sand samples from the base to top of the deposit were collected and examined for grain-size analysis. More than 75% of the sand from each sample occurs in 0.100 to 0.150 mm and falls within the fine sand grade.

The sand deposit was first subjected to geomorphological and sedimentological analysis. Later Joglekar *et al.* (1997, 2002) and Deo *et al.* (2001, 2006) identified it as an archaeological deposit. Therefore, it was necessary to understand the depositional environment of the sand deposit and the probable archaeological artefacts underneath, without unduly disturbing the deposit.

Methods Employed

Seismic Refraction technique deploying both compressional and shear waves was used to estimate the thickness and compactness of various subsurface layers in the sand deposit. Electrical Resistivity Imaging (ERI) and Ground Penetrating Radar (GPR) techniques were used to locate buried artefacts. A Differential Global Positioning System, which gives an accuracy of ±1m in position, was deployed to establish exact location of the site, including that of a well existing at the foot of the sand deposit. These techniques (Dobrin 1976; Griffiths and King 1981; Keary and Brooks 1984) are described concisely below.

Seismic Refraction Method

The Seismic Refraction method utilizes the existence of a recognizable difference in the velocities with which seismic (acoustic) waves produced by striking

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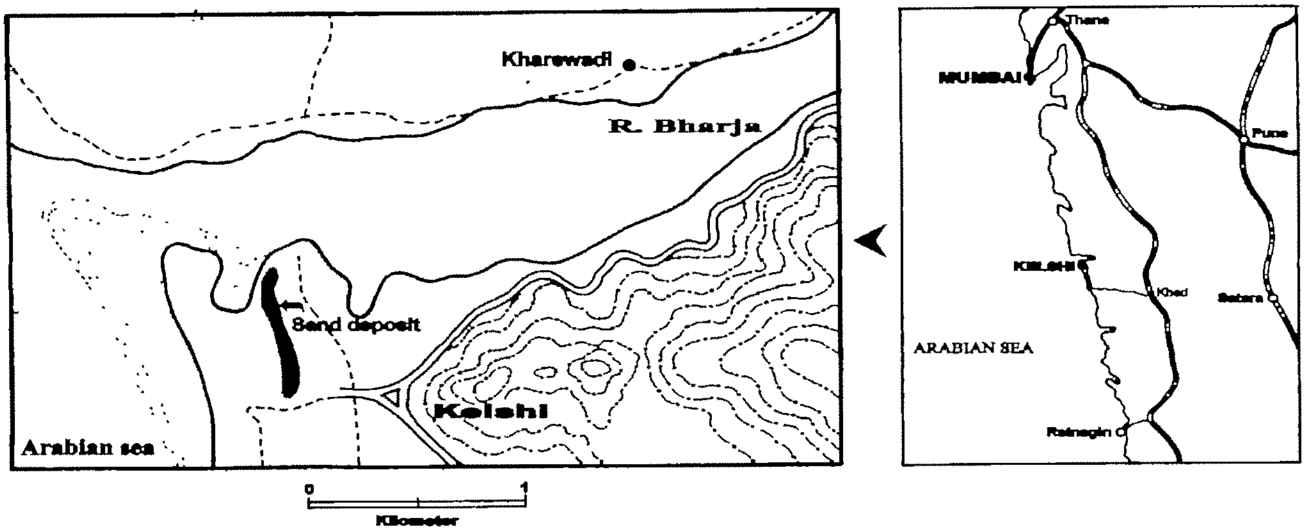

Fig. 1 Location map

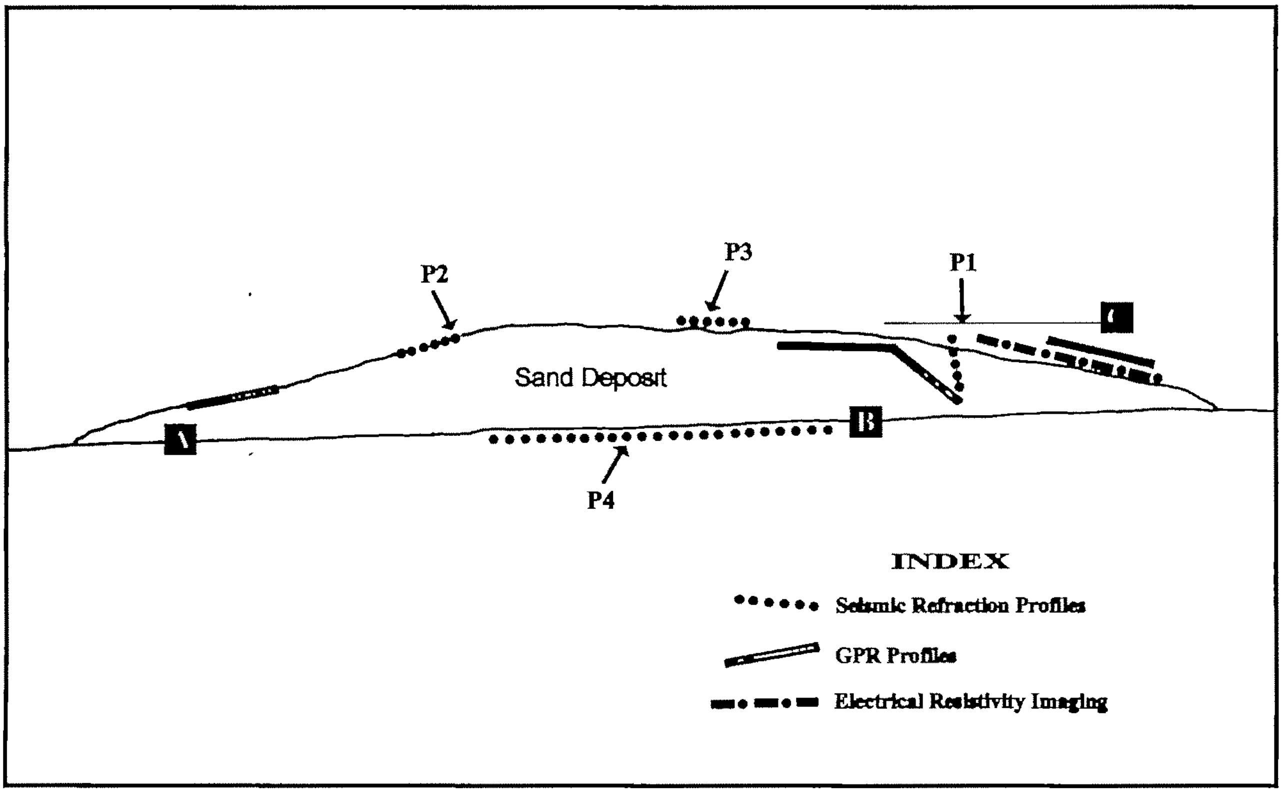

Fig. 2 Location of SR, GPR and ERI traverse

a metallic fibre glass plate with a 5 kg sledge-hammer are transmitted through various subsurface layers. The direct and refracted elastic waves after travelling through the surface and subsurface layers respectively are picked-up by 12/24 detectors (geophones) planted on the ground at 5 to 10 m interval in line with the source (hammer striking point). This set-up i.e. 12/24 geophones planted at 5 to 10 m interval in line with the hammer striking point is called the seismic profile. The result of seismic wave (both P- and S-) on the geophones showed low signal strength because of adsorption of wave by surface and subsurface strata and long distance travelling. To make them accurately readable on the seismic record these wave signals are amplified separately for each channel and are then recorded. The time of arrival of first wave i.e. compressional (P-) waves on each geophone is then measured from the refraction record on which a time scale is maintained or the same can also be read directly from the display in the seismograph using a cursor. Then from the measured arrival times of the geophones and their known distances, a time-distance graph is plotted. From the time-distance graph, the wave velocities corresponding to various subsurface layers are evaluated. The thickness of various subsurface layers depicted on the time-distance graph at each of the two hammer striking points is calculated either by time-intercept or by cross-over distance method. The thickness 'h_1' of the first layer is calculated using either of the following relations.

$$h_1 = Ti_1 / 2 \, x \, V_1 / Cos\,(\,Sin^{1}\,(V_1/V_2)\,) \qquad (1)$$

or

$$h_1 = X_c / 2 \sqrt{}(V_2 - V_1) / (V_2 + V_1) \qquad (2)$$

where

Ti_1: the intercept-time for the second layer

h_1: the thickness of the first layer

V_1 and V_2: velocities of the first and the second layer respectively and

X_c: cross-over distance.

The thickness 'h_2' of the second layer in case of three layer earth model is calculated by time-intercept method, using the relation

$$h_2 = ½\,(\,Ti_2 - Ti_1\,(Cosi_{\,13} / Cosi_{\,12}))\,V_2 / Cosi_{\,23} \quad (3)$$

where

'i_{12}', 'i_{13}', and 'i_{23}', are the critical angles for the first and second layer, the first and third layer and the second and third layer, respectively.

The generation, recording and identification of P- waves on the seismic record is straightforward because they travel the fastest and constitute the first occurrence of the wave on the seismic record. A 5 kg sledge-hammer and a specially designed metallic shear key is fixed firmly on to the ground to produce S-waves. Shear waves were detected and recorded by using horizontal geophones having a 8 Hz natural frequency. Shear waves were produced by hitting the shear key from two opposite directions. Reversing the direction of hitting the shear key, resulted in producing two wave forms (one for each direction of hitting) on which the shear motion was exactly reversed while P-wave energy remaining coincident. The recording of S-waves by reversing the direction of hitting helps in identifying them unambiguously on the seismic record. To ensure proper recording and identification of S-waves on geophones, located at farther distances from the hammer source, the hammer blows in each direction of hitting were stacked 15 times i.e. the blows for generating S-waves with source and geophones at the same location were repeated 15 times and the signal from consecutive blows was added together in the digital memory of the seismograph to achieve clear S-wave arrival.

For horizontal subsurface layers, seismic waves recorded from one end of the profile are enough to determine the true velocities and thickness of the subsurface layers. However, for dipping layers, seismic waves are recorded from both ends of the profile which help in evaluating the dip and true velocity of the individual layer. The velocity of propagation of seismic wave in a particular layer is indicative of its nature in terms of compactness, unsaturated or saturated, weathered rock or good quality rock.

A Seismic Refraction survey was carried out (Fig. 3) using a 24-channel signal enhancement seismograph (Terraloc Mark 6, manufactured by M/s ABEM Co, Sweden). The advantage of signal enhancement facility is that when impacts for generating seismic waves are repeated the subsequent signals are added together in the digital memory. The random background noise tends to cancel out while the in-phase signal grows progressively larger (signal enhancement). With this facility it is possible to record even weak signals. A 5 kg sledge-hammer and a thick circular fibre glass plate were used for generation of compressional (P-) waves while the sledge-hammer with metallic shear key firmly fixed to the ground was used for generation of shear (S-) waves. P- and S- waves on the ground surface were picked-up by 8 Hz vertical and horizontal geophones, respectively.

Electrical Resistivity Imaging (ERI)

Electrical Resistivity Imaging technique is best used for the investigation of sites with complex geology that can not be approximated to horizontal layer stratigraphy. This technique as opposed to routine profiling and sounding method involves measuring a series of resistivity profiles with different electrode spacing 'a'. A computer is used to control the

Seismograph Recording

Generation of sheer waves

Fig. 3 SR survey

measurements between selected sets of an electrode array i.e. Wenner, Schlumberger, Dipole-Dipole arrays. Since increasing electrode separations provide information from deeper depths. The measured apparent resistivity values are processed to provide the true resistivity and depth of various subsurface layers.

The final depth-section of ERI technique is an image of true resistivity with depth from which the subsurface geological information including that of isolated buried objects can be inferred. Resistivity imaging data collection technique is also known as the sounding-profiling technique as it involves both sounding and profiling measurements. Resistivity imaging survey was done using both Schlumberger and Wenner electrode configurations. Air-filled cavities or isolated objects that are resistive are depicted as high resistivity anomalies in the imaging section.

The Electrical Resistivity Imaging survey was conducted (Fig. 4) using 'Scintrex automatic resistivity imaging system (manufactured by M/s Scintrex Ltd, Canada). This is 100 Watt output power equipment and can transmit very high currents into the ground. The current and potential electrodes deployed were 75 cm long and 2 cm diameter, round stainless steel electrodes. Multicore cables with one take-out for each electrode were used to connect the instrument. The equipment comprises an electrode selector, a switching unit that is controlled by a computer to select the appropriate electrodes for automatic measurement. At the interface between electrodes and ground, salt water was added at the base of each electrode to minimize the contact resistance.

Ground Penetrating Radar (GPR) Survey

Ground Penetrating Radar (GPR) is the latest non-destructive geophysical exploration technique that has proven its tremendous potential for engineering applications. The GPR technique employs electromagnetic (EM) waves of frequency ranging

ERI recording

Cables with electrodes

Fig. 4 ERI survey

from 10-2000 MHz to map the subsurface structures and features, both natural and man-made. GPR provides high-resolution record of subsurface strata with relatively high survey speed. The technique is both time and cost effective.

GPR transmits EM waves of high frequency into the medium and the same after reflection from the subsurface are picked-up at the surface by a receiver. The transmitter and receiver pair is hosted in a box called "antenna". When the transmitted energy encounters strata having different electrical properties some of the energy is reflected back and the remaining is transmitted further downward. The receiver located inside the antenna will then receive the reflected signal. The elapsed time between wave transmission and reception is then measured from the GPR record. The antenna is continuously dragged on the surface with the antenna transmitting waves at the predetermined time and the reflected energy received to obtain a continuous record of the subsurface features.

The propagation speed of EM wave and the quantity of the reflection energy are affected mainly by the dielectric constant or relative permittivity and magnetic susceptibility of the medium. The velocity 'V' of EM wave in the medium is dependant on the real part of the dielectric constant 'ε' alone i.e.

$$V = C / \sqrt{\varepsilon} \qquad (4)$$

where

'C' is the velocity of light in air.

The energy reflected from interfaces also depends on dielectric constant 'ε'. The reflection coefficient 'K' at the interface is given by

$$K = (\sqrt{\varepsilon_2} - \sqrt{\varepsilon_1}) / (\sqrt{\varepsilon_2} + \sqrt{\varepsilon_1}) \qquad (5)$$

Thus, the reflected signal will be strong if the difference of the dielectric constant between target and the host material is large. On the other hand, the penetration of the EM wave depends both on the dielectric constant and conductivity (σ) of the media. The attenuation 'a' of EM signal is expressed as

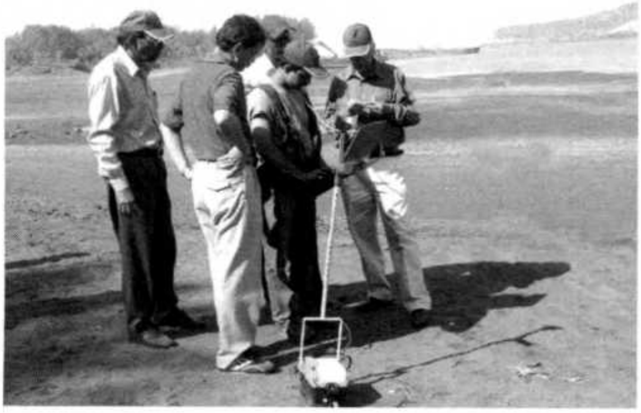

Fig. 5 GPR survey

$$a = (1635 * \sigma) / \sqrt{\varepsilon} \qquad (6)$$

The dielectric constant 'ε' for most of the dry geological materials varies from 4 to 8. Its value is 1 for air and 81 for water. Variations in the amount of water and air in a porous medium have a decisive effect on the propagation of the electromagnetic wave and its reflection and hence penetration.

GPR data are interpreted qualitatively in terms of subsurface anomalies from the two-way-travel-time (twt) and amplitude of the recorded signal. The depth of the reflected horizon or object or anomaly is determined from 'twt' obtained from the GPR record. The depth 'd ' of the reflector of interest is calculated by

$$d = (twt / 2) * (C / \sqrt{\varepsilon}) \qquad (7)$$

The higher frequency signals in GPR attenuate quickly, but attain higher resolution. On the other hand low frequency signals penetrate deeper, but the resolution is limited. The GPR technique works efficiently for the host strata (having resistivity > 100 ohm-m). In terms of geology this means that GPR will provide better and thorough information i.e. when a rock, which is generally highly resistive if exposed; rather than when it is covered by alluvial or sand deposit which is comparatively conductive. Selection of frequency for a particular survey depends upon the depth of interest and the size of the object to be detected. With the above in view, 250 and 800 MHz antennas were used for locating buried artefacts and anomalies.

GPR data were collected using (Fig. 5) a 'RAMAC' GPR system manufactured by M/s Mala Geosciences, Sweden. The GPR survey was conducted by deploying 250 MHz and 800 MHz shielded antennas. Frequency filters and triple time varying gains were used to get the good quality GPR data (Fig. 6).

Differential Global Positioning Survey (DGPS)

For establishing the latitude and longitude of the sand deposit including that of a well located at the foot of the sand deposit Differential Global Positioning Survey was carried out. The receiver of the GPS determines the range of the satellite using coarse Acquisition Code Correlation Technique. This technique estimates the time taken by the signal to travel from the satellite. The time is then used to calculate Pseudo ranges from four or more satellites from which the signals are being received. The GPS navigation algorithm estimates position of the receiver in three dimensions and time. The advantage of 'DGPS' over 'GPS' is that with extra receiver put at a known location the achievable accuracy of position co-ordinate determination becomes ±1 m while the same is about ±15 m when only GPS is deployed. In DGPS, the extra receiver kept at a known position measures the range to each satellite

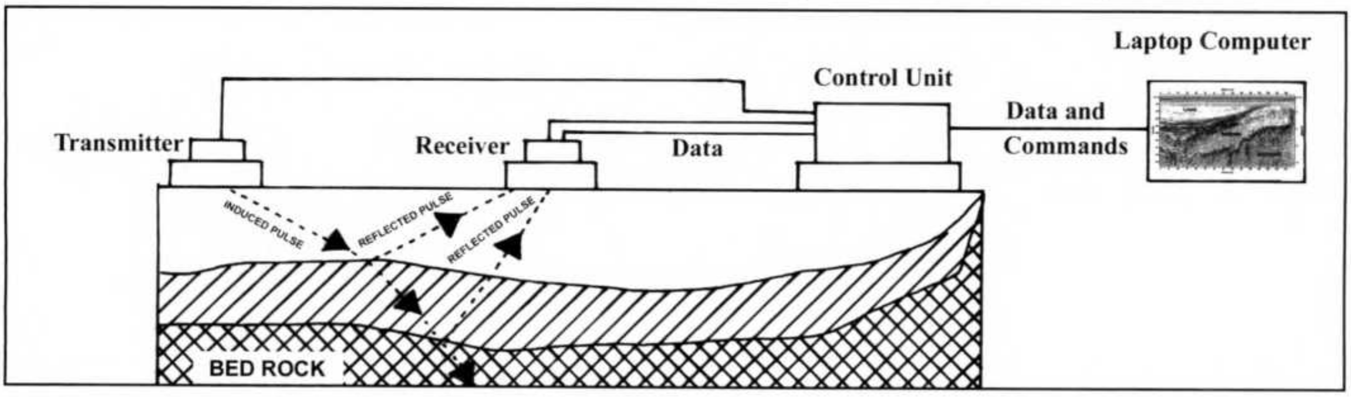

Fig. 6 Field-layout for GPR survey

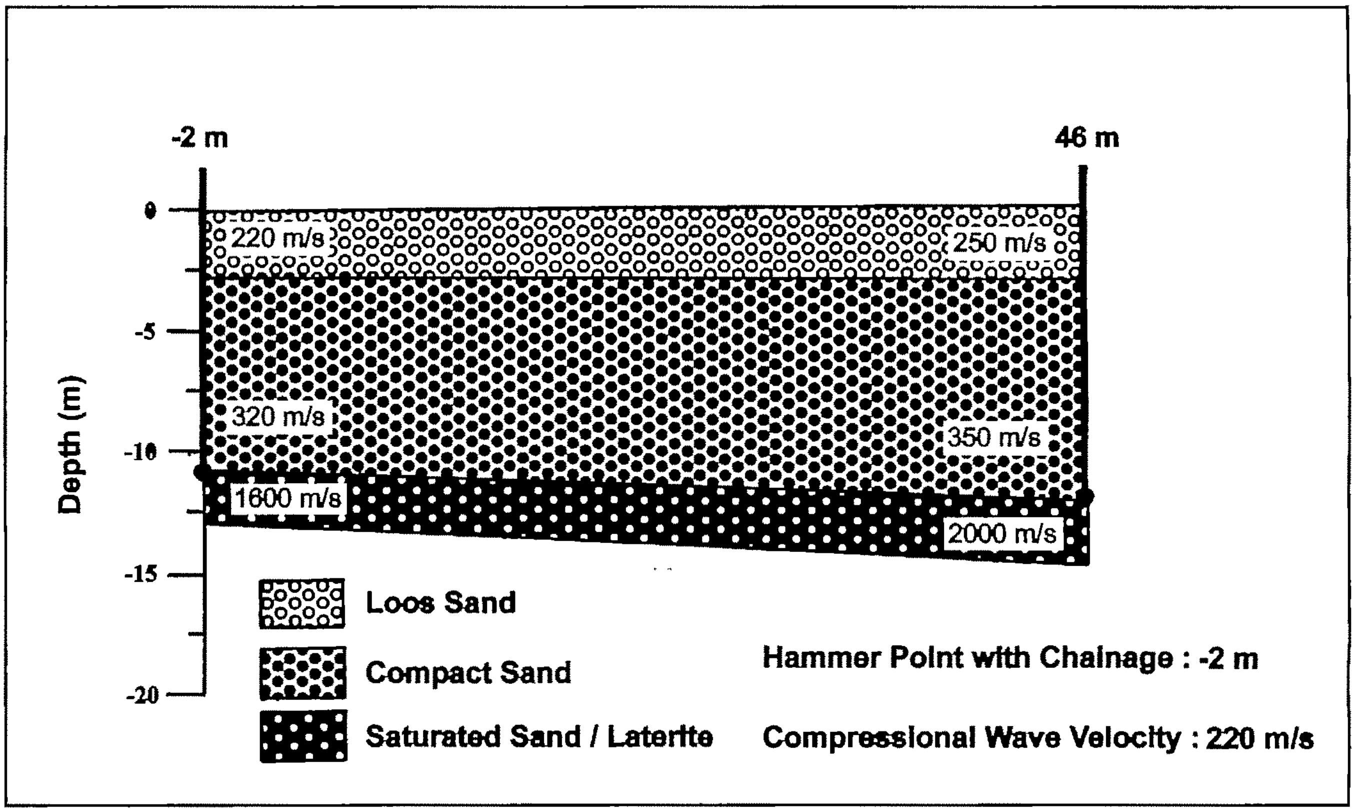
-2 m
46 m
0
-5
-10
-15
-20
Depth (m)
220 m/s
250 m/s
320 m/s
350 m/s
1600 m/s
2000 m/s
Loos Sand
Compact Sand
Saturated Sand / Laterite
Hammer Point with Chainage : -2 m
Compressional Wave Velocity : 220 m/s

Fig. 7 Depth-section along SR profile P1

using its channels and knowing its position calculates what each of the ranges should have been. Error in position measurement is calculated by subtracting the two values. The error data, for each tracked satellite is formatted into a correction message and is then transmitted. The GPS receiver on the survey vessel uses this correction data to correct its own satellite measurements. This way 'DGPS' can achieve a position measuring an accuracy of ±1 m.

Differential Global Positioning System (DGPS) manufactured by M/s Sokkia Pte. Ltd., Singapore was deployed. This system is a satellite based system and uses signal broadcast frequency of 1575 MHz ± 10 MHz. The system can track signals from up to 12 satellites. However, for accurate position determination signals from three/four satellites suffice.

Results

Seismic Refraction Survey

Four Seismic Refraction traverses (Figs. 7-10), three on the sand deposit (P1 to P3) and one (P4) on the beach were conducted to decipher subsurface stratigraphy. The typical depth-section along profile P1 of length 48 m is shown in Fig. 7. Along this traverse, three subsurface layers with average compressional (P-) wave velocity 240 m/sec for the top layer, 340 m/sec for the middle layer, and 1800 m/sec for the lowermost penetrated layer were deciphered. The top layer based on the P- wave velocity value was interpreted to be loose sand. The middle layer with P- wave velocity 340 m/sec was inferred to be somewhat compact sand without any moisture content. The small increase in P- wave velocity of the middle layer is attributed to increase in compaction of the top loose sand because of overburdening pressure. This inference was further substantiated by a small increase in shear (S-) wave velocity of the middle layer as compared to the top layer. The third or the bottom layer with average P- wave velocity 1800 m/sec may represent either fully saturated sand or laterite because these have similar P- wave velocities, and it is not possible to differentiate between the two. Similarly, the depth-sections as inferred from the results of the refraction survey along remaining two traverses (P2 and P3). Along these two traverses because of shorter spread lengths, only two subsurface layers have been inferred. These two layers based on P- wave

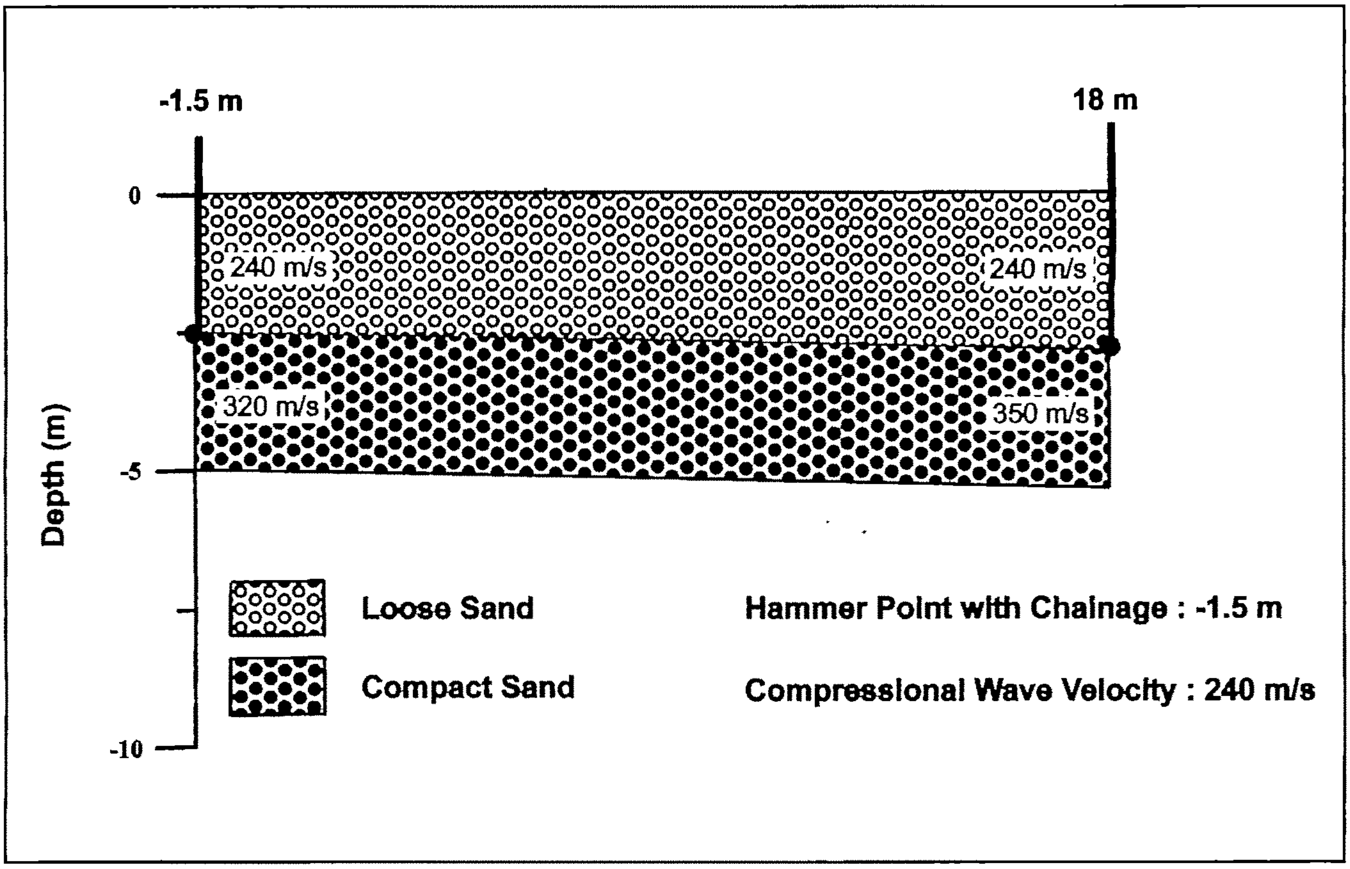

Fig. 8 Depth-section along SR profile P2

velocities and the calibrations adopted as mentioned above have been interpreted to be loose sand and somewhat compact sand, without any moisture content. These sections show that up to a certain depth there is no change in compaction.

Results of the 71 m long seismic traverse P4 conducted on the beach just adjacent to sand deposit revealed that the subsurface comprises two layers (Fig. 10). The top layer with P- wave velocity 1500 m/sec was interpreted to be saturated sand/laterite while the bottommost layer with velocity between 3500 m/sec and 4000 m/sec was interpreted to be weathered to good quality basalt rock. The depth of rock from the ground surface varied from 15m to 17m.

From these survey results it can be inferred that the sand deposit is of uniform nature without any change in compactness or moisture content. This inference is based on the fact that the wave velocities of the top and the middle layer of the deposit are similar. This means that the deposit is not the result of in-situ weathering. The effect of in-situ weathering would have been non-uniform and the compaction of the strata with sand deposit would have increased. Both these factors would have contributed towards higher velocities for the middle layer. This revealed that the sand got deposited over a short duration of time.

Electrical Resistivity Imaging

Electrical Resistivity Imaging profiling at zone marked as C was carried out (Fig. 4) to prove and verify some of the anomalies inferred from GPR record. For this 25 electrodes at 1 m interval were planted on the ground. The Schlumberger/Wenner electrical sounding profiling technique was used for data collection. The 2D true resistivity section confirmed the presence of the anomaly revealed by GPR which is highly resistive (100 Kohm-m) with respect to the surrounding media. The lateral and vertical extent of the anomaly on the true resistivity section matched with that inferred on GPR record. In recent visit to the site in August 2009, at this location there was a stone structure. The details can be made out after the excavation.

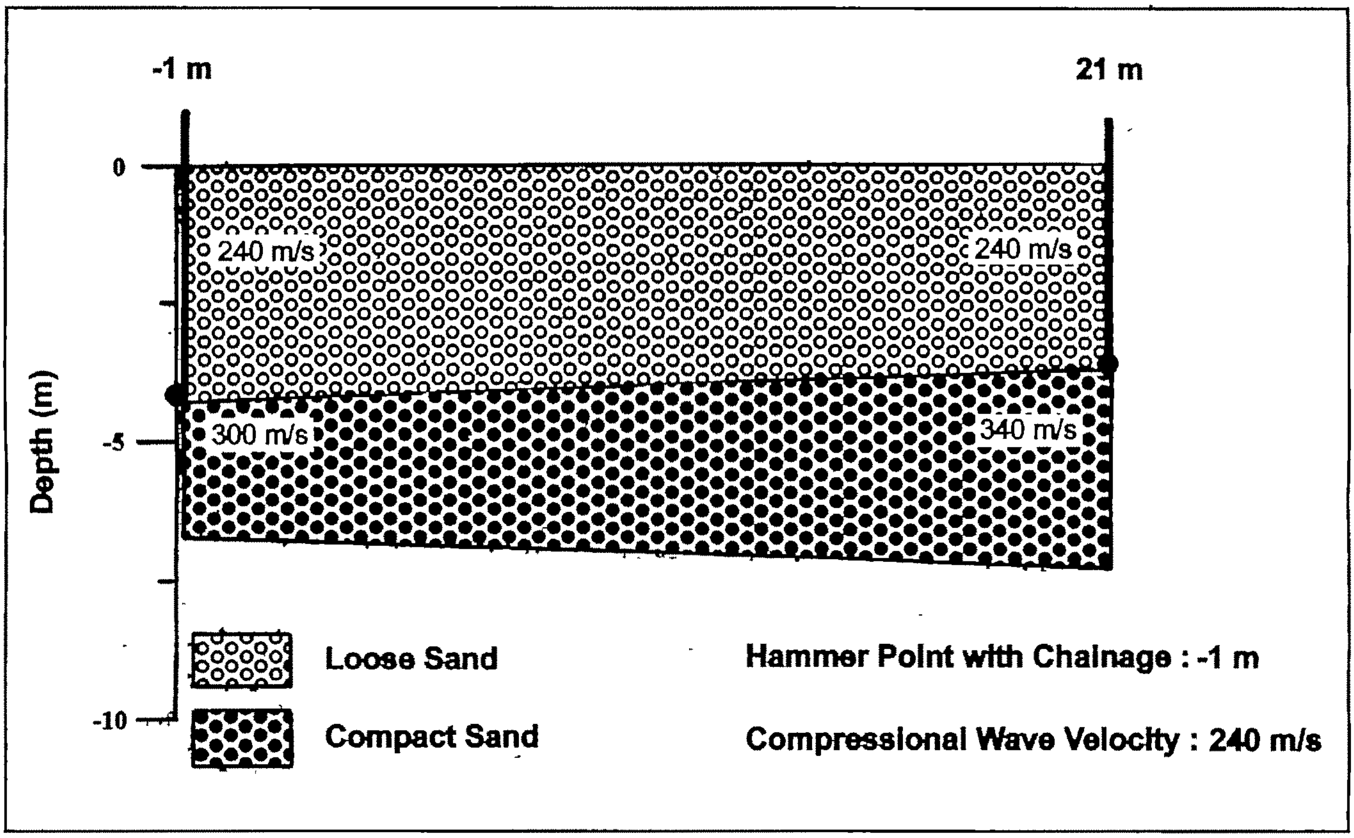

Fig. 9 Depth-section along SR profile P3

Ground Penetrating Radar Survey

At site marked as 'A' and located on the northern end on the deposit, a man-made structure resembling a wall of laterite blocks is exposed at the edge of the deposit towards the seashore. To track the subsurface spread of this structure three GPR profiles in N-S direction deploying 250 MHz antenna were conducted. The results of GPR revealed the spread of this structure up to 2 m depth and its lateral extent was measured to be about 5 m. Signatures of the anomaly along with two profiles are shown in Fig. 11.

At site 'B' two long GPR profiles in the middle and top of the deposit were taken. Along these profiles no aberrations were seen on the GPR records. It was inferred from this that the area is devoid of any external material. When the middle profile was extended to cover the lower portion of the sand deposit towards south, some buried, isolated objects were inferred at a depth of 1.2 to 2 m on the GPR record (Fig. 12).

At location marked as 'C' situated on the southeastern side of the deposit, 14 GPR profiles were conducted in N-S direction. From these records it was inferred that about 10m long and 2 m wide subsurface anomaly exists in E- W direction at a depth varying from 1.0 m to 2.2 m. On two profiles signature of the anomaly were observed (Fig. 13). During the verifying visit to the site in August 2009, it was found that at these locations there are lateritic blocks suitably arranged. The particulars of the structure can be understood only after the excavation.

Differential Global Positioning Survey

The plot of the profile taken to establish the geocordinates is shown in Fig. 14. Each measurement point is marked as Fix 1, Fix 2 etc. A total of 27 fixes starting from the bottom up to the top were taken. Fix 1 is the starting point of the profile and represents the location of an ancient well at the base. Fix 2 is situated on the northern boundary of sand deposit and a profile was conducted towards southwestern direction. The deposit has a bend at Fix 11 and continues in south direction where the elevation of the deposit increases. Fix 27 is located at the top of western side of the deposit. Elevation of the Fix 27 is the present top of the deposit.

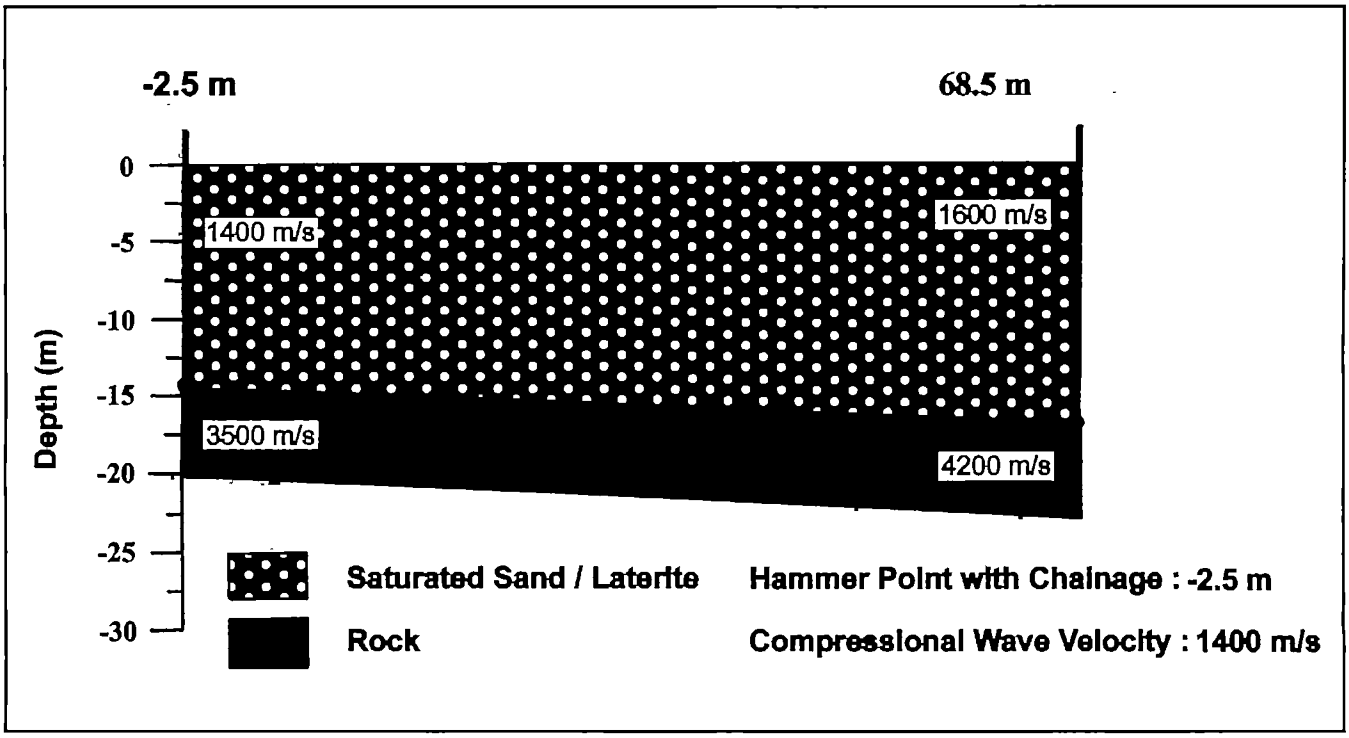
-2.5 m
68.5 m
Depth (m)
0
-5
-10
-15
-20
-25
-30
1400 m/s
1600 m/s
3500 m/s
4200 m/s
Saturated Sand / Laterite
Rock
Hammer Point with Chainage : -2.5 m
Compressional Wave Velocity : 1400 m/s

Fig. 10 Depth-section along SR profile P4

Conclusions

Results of the Seismic Refraction survey along the traverse of 48 m length revealed three subsurface layers. Along two shorter profiles, only two subsurface layers were inferred. The top layer with a compressional wave velocity 240 m/sec was interpreted to be loose sand. The middle layer with a compressional velocity 340 m/sec was interpreted to be little compact sand. The third layer with a compressional wave velocity 1800 m/sec may represent either saturated sand or laterite. From the refraction survey results, it was inferred that the sand deposit is of uniform nature and it was not the result of *in situ* weathering but was deposited in a short period of time. GPR survey at one of the locations revealed an anomaly at average depth of 1.5 m with lateral extent of 10 m. With closely spaced GPR profiles the width of this anomaly was estimated to be 2 m. The existence of this anomaly on GPR record was confirmed by ERI results. At the northern edge of the deposit near the shore, a man-made structure constructed by using laterite blocks was exposed. The results of GPR over the buried part of the structure revealed the depth of structure to be 1.5 m and its lateral extent was evaluated to be 5 m.

Acknowledgements

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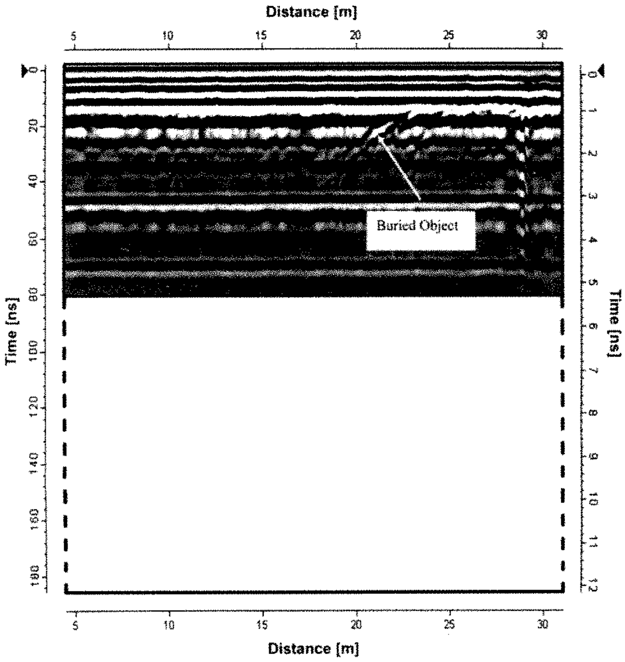

Fig. 11 GPR record along a profile at location 'A'

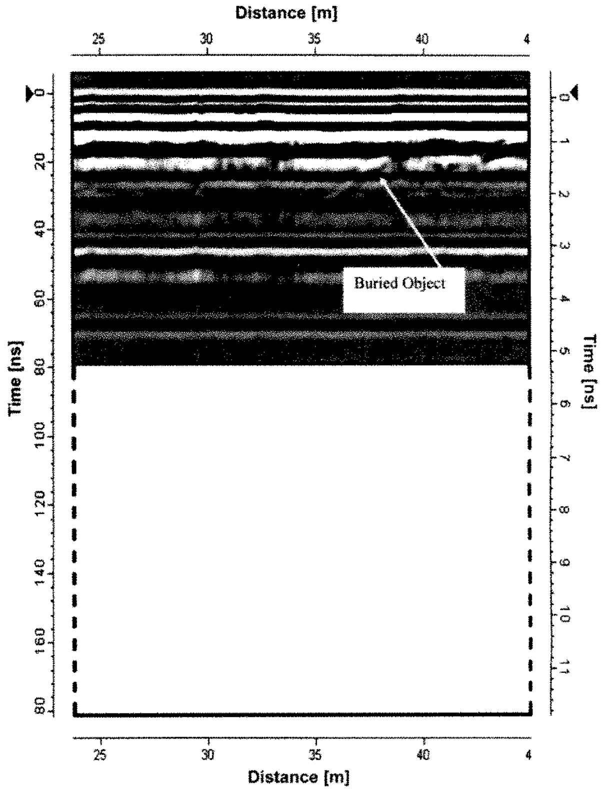

Fig. 13 GPR record along a profile at location 'C'

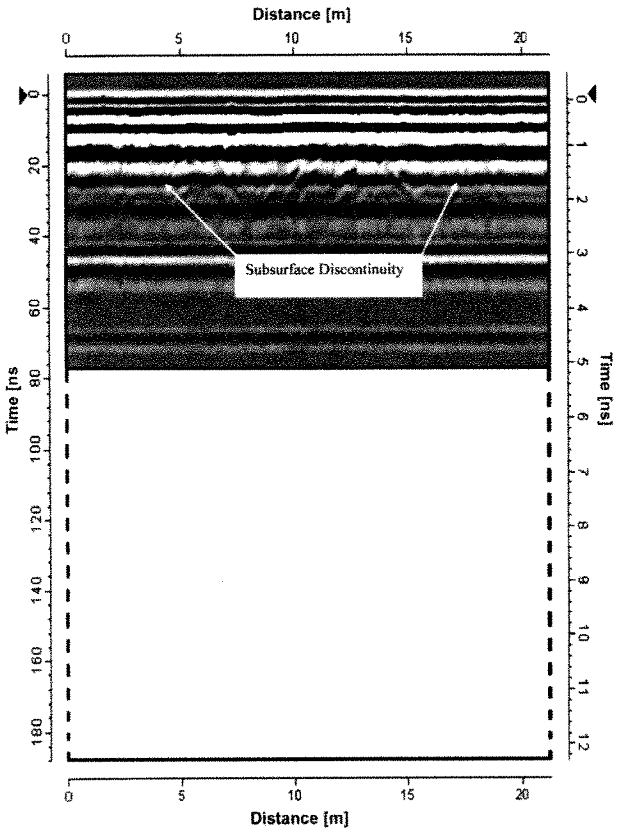

Fig. 12 GPR record along a profile at location 'B'

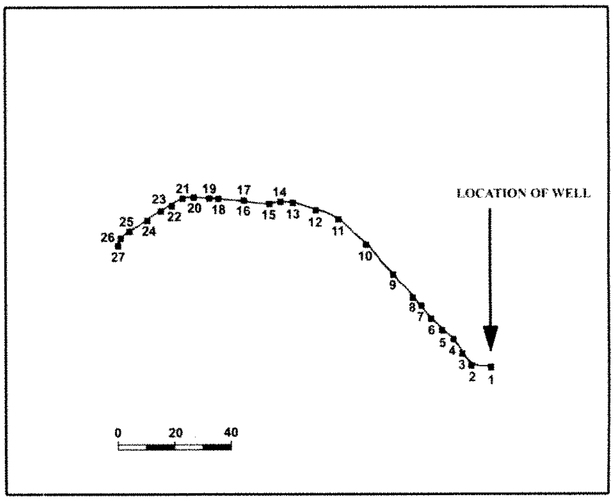

Fig. 14 DGPS profile from bottom to top of the sand deposit

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Updates on the Antiquity of Iron in South Asia

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Abstract

The role of iron has been emphasized from time to time in the development of human cultures. According to the prevailing view its introduction in the Ganga Plain is associated with the arrival of the Aryans from the west around 1000 B.C. Available conventional radiocarbon dates also support this hypothesis to a certain extent. Doubts have been expressed about an earlier antiquity for iron. Against this background, the advent of iron in the Ganga Valley is datable from the early to late second millennium BC on the basis of conventional and calibrated radiocarbon dates. Some scholars have refuted the new early evidence of iron on various grounds. This paper deals with these doubts in the light of new evidence.

Background

In 1950, D.H. Gordon (1950), in his book, *The Prehistoric Background of Indian Culture* observed that there was no evidence for the use of iron in South Asia prior to B.C. 250. Sir Mortimer Wheeler (1959) expressed the view that iron was introduced by diffusion from the west with the advent of the Achaemenids during the 6th century B.C. Chakrabarti (1974: 354) disagreed with this theory and opined that "there is no logical basis to connect the beginning of iron in India with any diffusion from the West, from Iran or beyond." One or the other of these opposing views has subsequently been espoused by archaeologists dealing with this issue, and debates on the implication of their views continues. With the increasing pace of new discoveries, the antiquity of iron in South Asia has been pushed back from 1000 to 600 B.C. and subsequently to 1300/1200 B.C. The status of research on the subject continues to be reviewed periodically (e.g. Banerjee 1965; Chakrabarti 1976, 1992, 2006; Nagaraja Rao 1971, 1974; Jacobson 1979; Agrawal 1982, 2000; Allchin and Allchin 1983, 1997; Possehl and Gullapalli 1999; Tripathi 1976, 2001).

Recently, Tewari (2003) reported new evidence for the appearance of iron at sites in the Central Ganga Valley dating back to the early half of the second millennium B.C. His suggestion for a fresh review of issues related to the appearance of iron in the Ganga Valley (Tewari 2003: 644) has found some takers. In particular Mandal (2009) and Suraj Bhan (2006, 2007) refuted the higher antiquity of iron at these sites as well as in India as a whole on the grounds that: 1) only conventional radiocarbon dates should be relied upon instead of calibrated values; 2) early dates from Gufkral, Raja Nala-ka-tila (RJN), Malhar, Dadupur, etc. are inconsistent; 3) charcoal samples giving an early date from Malhar might belong to an older tree (possibly 500-1000 years old); 4) the date from Malhar does not match global profile; and 5) the stratigraphy at some of these sites is not reliable. Further, they emphasised cultural perspectives regarding the appearance of early iron, particularly in the Ganga Valley. In this paper the author focuses on these and related issues.

Data and Analysis

Copper/Bronze Age

Iron artefacts have been found in Copper/Bronze Age contexts at the Harappan levels at Mundigak, Chanhudaro, Lothal, Allahdino, and other sites. Considering these finds, Chakrabarti and Lahiri (1994: 14-15) expressed the view that the technological base for the production of iron was present at various sites which have Mature Harappan and Late Harappan affinities. Possehl and Gullapalli (1999: 159) state that: '... we do not know which of them (iron pieces and objects) is meteoritic and which

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(if any) were smelted. What follows is a compilation of evidence that demonstrates an early knowledge of iron in at least mineral form.' In contrast Tripathi (2001: 66, 71) thinks that the finds from Afghanistan sites appear non-metallic. She also says that it is not possible to attribute knowledge of iron smelting to the smiths of Lothal. In any case, the presence of iron artefacts (metallic or non-metallic clapper, button, pointed blade, pin and band) at so many sites between *c.* 2700-2000 B.C. apparently shows evidence for deliberate shaping.

North-West

Excavations at the well-known Neolithic site of Gufkral have brought to light a cultural sequence of five periods of occupation from the Aceramic Neolithic to the Historical period (Sharma 2000:111). Iron artefacts have been found from the middle levels of Period II (50-60 cm thick) onwards. Considering four ^{14}C dates from the lower levels of this period, the date for introduction of iron has been placed at *c.* 1850 B.C. Mandal (2009: 5) considers that 'it is based on an extrapolation from the dates of earlier level having no iron.' In this regard it is notable that in a 50-60 cm thick deposit iron appears from the mid levels, and dates for the remaining lower deposit range between cal B.C. 1888-1674 and B.C. 2195-1900. Therefore, estimation for the date of advent of iron after cal B.C. 1888-1674 seems quite reasonable. The dates available for the levels just below them certainly provide a dependable base line.

The site of Pirak in the Kacchi Plain of Baluchistan was excavated between 1968 and 1974. Iron bearing levels of Period III, comprising grey or black wheel-made burnished pottery and other cultural material, has been dated from the 12th century B.C. by Jarrige and Santoni (1979: 44, 373) on the basis of ^{14}C dates. Possehl and Gullapalli (1999: 157) have suggested that period III begins from c. 900 B.C.

Iron, represented by a spearhead, arrowhead, pin/nail, spoon, finger ring and cheek bar, appears in Period VII in Ghalighai cave along with grey, red and brown wares, grave goods of copper, gold, silver, glass and bone, terracotta beads, etc. (Stacul 1967), and is placed around 1000+ (Chakrabarti 1992: 50). The presence of iron artefacts in large numbers and in different types is indicative of an earlier beginning of iron technology in the region.

Wheeler (1962) claimed that during his 1958 excavations at Bala Hisar at Charsadda, iron was found in the earliest levels of his deep trench (Ch. I, levels 50-51). He dated these layers to the 6th century B.C. (Wheeler 1962: 34), as he believed that iron was not known in the Indian subcontinent before the expansion of the Achaemenid Empire into Gandhara. Since then, there has been considerable debate about the date of the foundation of the site, with Dittman (1984) suggesting a date of *c.* 1400 B.C. and Vogelsang (1988) proposing a date of *c.* 1000 B.C. New excavations were conducted at Charsadda under a collaborative project between the Universities of Peshawar and Bradford with the objective of establishing a chronometrically based chronology (Conningham and Ali 2007). During the course of excavations, thirteen radiocarbon samples were collected from four trenches, and processed at laboratories in Oxford and Groningen (Conningham and Batt 2007; McDonell and Conningham 2007). During calibration, these dates were constrained through the use of Bayesian statistical functions in OxCal. These dates confirm that Bala Hisar was occupied as early as the 14th century B.C., and not in the 6th century B.C. as thought by Wheeler.

Wheeler discovered iron in the earliest occupation levels of his Ch. I trench at Bala Hisar (i.e. levels 50-51). If these levels are placed in the 14th century B.C., this would also be the date for the appearance of iron at this site. But, it is important to note here that no iron artefacts were recovered from primary contexts during the Peshawar/Bradford excavations (McDonell and Conningham 2007). This means that it is not possible to confirm unequivocally that iron was in use at Charsadda as early as the 14th century B.C. However, iron working residues were recovered from Period II deposits that have been radiocarbon dated to 1200-900 B.C. Therefore, according to McDonell and Conningham (2007), the beginning of iron use at Bala Hisar may be pushed back to *c.* 1200-900 B.C.

West and Central India

On the basis of cultural sequence, ^{14}C dates and iron artefacts detailed in Ahar excavation report (Sankalia *et al.* 1969), Sahi (1979: 366) suggested that "the introduction of iron at the site may well go up to the beginning of the 16th century B.C." and that "by about the early decade of thirteenth century B.C. iron smelting, was definitely known in India on a bigger scale." These suggestions generated a lot of discussion. Chakrabarti (1984: 82-83) supported them. Allchin and Allchin (1983: 325-26, 345) add that "Without further excavation this conclusion must be treated very cautiously." Nevertheless, most scholars did not agree with these views (Gaur 1997: 242-243; Prakash and Tripathi 1986: 569-70; Lal 1989: 109-112; Deo 1991: 197; Erdosy 1995: 83). The main arguments put forward were: 1) the stratigraphic context of iron artefacts is disturbed due to pit activity; 2) the trenches at Ahar were laid down on the sloping edge of the mound, due to which there is a likelihood that material from upper levels percolated down to lower levels which also yielded inscribed seal impressions of the 3rd-2nd century B.C., while others contained cast copper coins. Sahi (1995: 46) has consistently contested in favour of his view. However, most scholars do not accept it.

Pandey (1976, 1982) claimed that iron was present in the lowest levels of Eran Period II. According the Tripathi (1995:60-61), of the two radiocarbon dates (TF-326 and TF-324) obtained by Pandey, TF-326 from the lower layer (16) is later than TF-324 from the of upper layer (14), and that "stratigraphy and the original form of the Iron recovered from these two layers (16) and (14), respectively have not been discussed while revising the date (1300-700 B.C.) of Iron Age at Eran". Further, considering the outcome of the subsequent excavations, Tripathi (1995: 60-61) opined that "... it was noticed that in most of the trenches two or three deep pits were encountered from the historical phase down to the natural soil. Due to the disturbances caused by the pits, the material is also disturbed. It can be presumed that previously also such incidents took place and the upper Chalcolithic material got mixed up with the early historical material. ... in view of the facts and ^{14}C dates mentioned above, it is difficult to accept the revised early date of *c.* 1300 B.C. for the introduction of iron at Eran." It may be noted here that judging the conclusions drawn on the basis of one excavation on the parameters of the outcome of the other one's may or may not be conclusive. Excavations by different scholars at the same site may yield similar results, but they also may differ to a greater extent depending on the location and settlement pattern of a particular period in the ancient past. We may cite Jhusi as an example in this context. In the beginning, excavations revealed the cultural material of pre-NBPW phase (Misra *et al.* 1996). Subsequent excavations at the same site provided new evidence datable to mid 2nd and thereafter to *c.* 7th millennium B.C., respectively (Pal 2008). In this case, if the area providing early evidence was excavated first, followed by subsequent excavations in the areas of later deposits, the outcomes of each season would have contradicted each other, and, on the grounds being applied for Eran by Tripathi, the earlier results would have been wrongly declared unreliable.

Eastern Deccan

Calibrated ^{14}C dates for the iron bearing deposits at Adam in eastern Deccan range between *c.* 10th and 14th century B.C. The presence of plain and painted Black-and-Red Ware in this deposit is notable. The observations regarding the early dates for the iron bearing deposits of Adam (Tewari 2003) are based on personal communication from the excavator. The report of this excavation, when published, will provide further details. Date PRL-1456 from layer (15) is later than those from layers (12) and (11) and PRL-1369 from layer (17) is later than i.e. PRL-1368 from layer (16). Therefore, these dates are inconsistent. However, the remaining three dates (around B.C. 1400-1300) for the early iron bearing layers (11) and (12) are consistent with one another.

South India

Nagaraja Rao (1971) had proposed *c.* 1000 B.C. for the appearance of iron at Hallur on the basis of ^{14}C dates. The cultural sequence of this site comprises: Period I - Neolithic/Chalcolithic, and Period II - overlap of Chalcolithic and Early Iron Age cultures. Since the calibrated ^{14}C date for the latest Chalcolithic layer, immediately below the layers of Period II, is B.C. 1426 – 1132, and Period II is marked by the arrival of a new wave of iron-using people, it is reasonable to place the beginning of iron at this site in the late second millennium B.C. Recent AMS dates form this site (Fuller *et al.* 2007) (Fig. 1) also attest to this chronology (1200-1100 B.C.).

Relevant Phases of Watgal (District Raichur, Karnataka) (Devaraj *et al.* 1995) comprise Occupational Phases IIB-IV. Occupation IIB (2300-2000 B.C.) has yielded paste beads cut with metal tools but no metal object is unquestionably associated with this phase. The very small iron fragment present in the cultural assemblage has been considered an

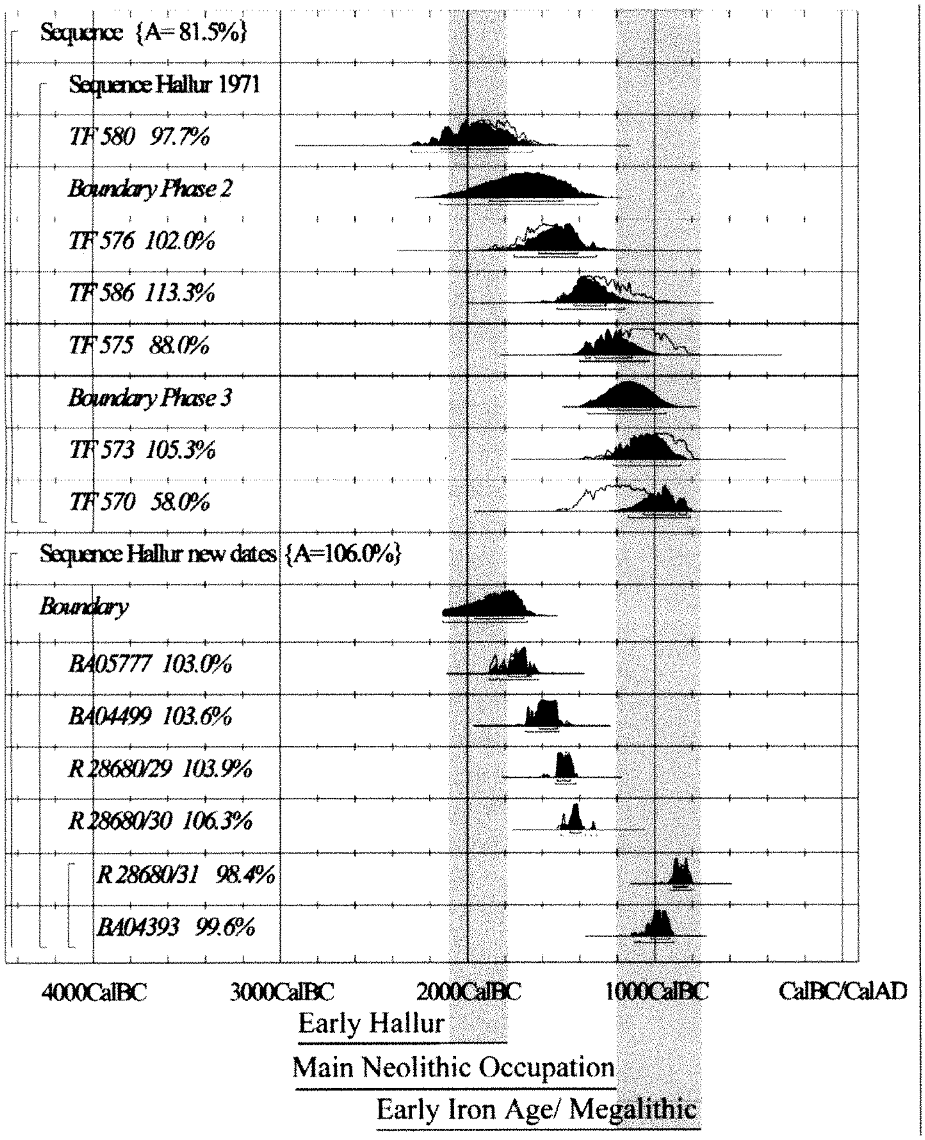

Fig. 1. Recent AMS dates from Hallur based on a specific Bayesian calibration model (After Fuller *et al.* 2007)

intrusion from a later occupation. From Occupation III (Post-2000 B.C.) six copper/ bronze objects are reported and three small iron fragments, considered intrusions from the later Occupational phase. Occupation IV (Post-1500 B.C.) is represented by megalithic deposit which has yielded nine iron artefacts.

According to S.B. Deo (1991: 193) "the dates for megalithic and hence Iron Age" from the sites of Komaranhalli (between TL dates B.C. 1380 ± 300 - B.C. 930 ± 470) in Karnataka and Veeerapuram (PRL-728: cal B.C. 1257-cal B.C. 1234, cal B.C. 1217-cal B.C. 895, cal B.C. 866 - cal B.C. 864; PRL-729: cal B.C. 1207 - cal B.C. 1203, cal B.C. 1195 - cal B.C. 1140 cal B.C. 1134 - cal B.C. 832; PRL-730: cal B.C. 1608 - cal B.C. 1260 cal B.C. 1227 - cal B.C. 1221 and Ramapuram BS-383: cal B.C. 1598 - cal B.C. 1595, cal B.C. 1531 - cal B.C. 1266; BS-386 cal B.C. 1608 - cal B.C. 1567, cal B.C. 1565 - cal B.C. 1371, cal B.C. 1345 - cal B.C. 1316 (Andhra Pradesh) assume importance.

Uttarakhand

Agrawal *et al.* (1995: 84-85) published a ^{14}C date (PRL-1648: 2770 ± 90 BP (820 B.C.); cal 1022-826 B.C.) from an old iron working site in Kumaon and reported several megalithic sites in this area. Nautiyal *et al.* (1991: 29-35) dated the iron found at Malari in a megalithic cave burial to *c.* 1000 B.C. on the basis of associated pottery. Both teams believe in the Central Asian affiliation of these finds. Considering the availability of iron ore in sufficient quantity in Uttarakhand, the tradition of iron smelting, and one ^{14}C date of *c.* 1000 B.C., there is a strong probability of Uttarakhand being an independent iron using centre.

Ganga-Yamuna Doab

Over the past five decades, there has been a continuing debate on the date of the PGW phase in the Ganga-Yamuna Doab and Eastern_Rajasthan. Lal (1954-55: 23; 1977-78) suggested a chronology of *c.* 1100 – *c.* 800 B.C. for this cultural phase with a probable margin on the earlier side. Gaur (1983) argued for a time-span of *c.* 1200 - 600 B.C. for the iron bearing PGW phase (Period III) of Atranjikhera. Agrawal (1984) suggested a shorter chronology of *c.* 800 - 300 B.C. Peter Magee (2004: 42), in view of recent advances in ^{14}C calibration and archaeological interpretation, has concluded: "The combination of dates that extend to the end of the second millennium B.C. at Noh and Atranjikhera, and the samples which come from the middle and late PGW levels and which date as early as the ninth century B.C., leave little doubt that the upper bracket of Lal's chronology of 1100 to 800 B.C. is not contradicted by the ^{14}C evidence."

Excavations at Atranjikhera (District Etah, U.P.) revealed iron objects, furnaces, slags and certain specific tools used by blacksmiths, which suggest manufacture of iron goods and smelting of iron along with PGW in all cultural layers of Period III (Gaur 1983: 6-10, 21). Considering the ^{14}C date (TF-191: 1025 ± 100 B.C., cal. 1155/1165 B.C.), R.C. Gaur assigned a time span of *c.* 1200 - 600 B.C. for this period. Mandal (1972: 164) remarked that "TF 191 was originally assigned to the earliest level of the PGW deposit but later on the excavator (Gaur 1965: 142) modifying the level of derivation assigned it to mid level. There is some controversy on its level of derivation, however, it is immaterial as this date is not valid." It may be noted here that this observation was made regarding the paper submitted by Gaur to the seminar on Indian Prehistory held in 1964 at Pune. Gaur carried out excavations at Atranjikhera carried out between 1962 and 1969, and he probably submitted his paper on the basis of preliminary observations, and would have made modifications in the light of further excavations. If we consider this date from the earliest level, it would still have due relevance. According to Magee (2004:42) this "date indicates clearly that the earlier PGW horizon at the site dates to sometime after 1370 B.C." Regarding the second date TF-291 (cal. B.C. 764, 410, 390 (Possehl and Gullapalli 1999: 167) from the late level of PGW deposit Magee thinks that "A date of sometime after 800 B.C. for the succeeding phase of PGW is suggested by TF 291." Since iron is represented from the lower levels of the PGW deposits, the antiquity of iron at this site will also be somewhere around 1200 B.C.

Excavations at Jakhera (District Etah, U.P.) have revealed a four-fold culture sequence (Sahi 1994: 139-153). Periods I to IV are characterized by OCP, plain Black-and-Red along with black-slipped

Table 1: Radiocarbon dates from Dadupur (calibration of dates by B. Sekar#)

Laboratory No.	^{14}C Dates in BP (Half life 5730 years)	Calibrated ages in B.C. One Sigma Ranges: [start: end]	Relative Area
BS-1822: L. (9) 2.40-2.50 m	3368 ± 080	cal B.C. 1747: cal B.C. 1602	0.768765
		cal B.C. 1590: cal B.C. 1533	0.231235
BS-1759: L. (10) 2.75 m	3480 ± 160	cal B.C. 2023: cal B.C. 1989	0.063006
		cal B.C. 1985: cal B.C. 1612	0.936994
BS-1825: (Pit-sealed by L. (12)	3532 ± 090	cal B.C. 2007: cal B.C. 2004	0.00923
		cal B.C. 1975: cal B.C. 1744	0.99077
BS-1829: L. (12) 3.30-3.35	6334 ± 120	cal B.C. 5471: cal B.C. 5210	1.00

# CALIB Radiocarbon Calibration Program (Copyright 1986-2010 by Stuiver and Reimer 1993) to be used in conjunction with Reimer *et al.* (2009)

Table 2. Radiocarbon dates from Raja-Nala-ka-tila (calibration of dates by B. Sekar)

Laboratory No.	^{14}C Dates in BP (Half life 5730 years)	Calibrated ages in B.C. One Sigma Ranges: [start: end]	Relative Area
PRL-2047 (1996-97) Trench No. U-20, L (6) (2.08-2.10 m)	2980 ± 90	cal B.C. 1212: cal B.C. 973 cal B.C. 958: cal B.C. 938	0.939428 0.060572
PRL-2049 (1996-97) Trench No. T-19, L (7) (2.40-2.45 m)	3150 ± 90	cal B.C. 1431: cal B.C. 1208 cal B.C. 1196: cal B.C. 1196 cal B.C. 1139: cal B.C. 1135	0.985375 0.002877 0.011748
PRL-2046 (1996-97) Trench No. U-19, L (9) (2.80 m)	3200 ± 90	cal B.C. 1493: cal B.C. 1475 cal B.C. 1461: cal B.C. 1265	0.061948 0.938052
PRL-2045 (1996-97) Trench No. U-20, L (10) (2.90 m)	3360 ± 90	cal B.C. 1629: cal B.C. 1436	1.00

and red wares with iron, proto-PGW, PGW, and NBPW, respectively. No ^{14}C date is available for the deposits of Jakhera. Its Period II has been compared with Period II (*c.* 1450-1200 B.C.) of Atranjikhera, Noh, and Jodhpura (Sahi 1994:140-142). It is also comparable with Period I of Dadupur and Period II of Abhaipur (1360 B.C.). Three ^{14}C dates from Dadupur date Period I to c. B.C. 1800-1500. In view of these evidences the appearance of iron in Period II of Jakhera may be safely placed in pre-12th century B.C.

A new series of ^{14}C dates from Abhaipur (District Pilibhit, U.P.) (Mishra and Arora 2006), comprising four cultural periods (marked by the presence of OCP, Black-and-Red Ware, PGW, and NBPW respectively), show that amongst the two consistent dates BS-2395: cal B.C. 1371 - 980 belonging to Period III corresponds well with TF-191 of Atranjikhera. Notably about 30-50 cm thick deposit, underlying the level from which sample for this date was collected, indicates the probability of even an earlier antiquity.

Excavations at Dadupur in Sai Valley, District Lucknow have revealed a three-fold cultural sequence (Tewari *et al.* 2002). The deposit of Period I contains iron artefacts. Dull red ware dominates the pottery assemblage, while the Black-and-Red Ware is nominally represented. Periods II and III are characterised by the presence of PGW and NBPW respectively. Out of three successive floors marked in Pd. II, two of the earlier ones are based on the uppermost layer (8) of Pd. I. Four radiocarbon dates are available from this site (Table 1). The earliest of them (i.e. BS-1829 - cal B.C. 5471 – cal B.C. 5210) is apparently out of context. Of the remaining three two BS-1822 (cal B.C. 1747 – cal B.C. 1533) and BS-1825 (cal B.C. 2007 – cal B.C. 1744) are quite consistent with each other as well as with the stratigraphic context. The third date, BS-1759 (cal B.C. 2023 – cal B.C. 1612) compared to BS-1825, is not much off the mark. Therefore, these dates attest to the presence of iron in the first half of the 2nd millennium B.C. at this site.

Mandal (2009: 9-11) considers the iron-bearing deposits of Dadupur as re-deposited. Also, there are some inconsistencies in the preliminary report and re-exploration and re-excavation of this site are required. Notably, it is clearly stated in the preliminary report that the lower layers in the concerned trench dip towards one side (Tewari *et al.* 2002). The excavators are well aware of the nature of such deposits and they also know that the deposits in a depression may be consistent and reliable, provided the associated material and dates support them. The iron-bearing deposits at this site, below the PGW layers, have not yielded PGW or mixed cultural assemblage, and the dates are consistent with each other. Therefore, the respective dates are dependable for suggesting a chronological sequence. Further investigation at the site is welcome but with the rider that one should not assume the status of a judge.

Central Ganga Plain and Eastern Vindhyas

The presence of iron in Period II (layers (7) – (5) in association of early Black-and-Red Ware pottery (supposed to be the hallmark of the Chalcolithic

Table 3 Radiocarbon dates from Raja-Nala-ka-tila (calibration of dates by B. Sekar)

Laboratory No.	^{14}C Dates in BP (Half life 5730 years)	Calibrated ages in B.C. One Sigma Ranges: [start: end]	Relative Area
BS-1988 (1996-97), Trench No. U-19, l. (5) (1.40-1.30 m)	2690 ± 070	cal B.C. 893: cal B.C. 877 cal B.C. 846: cal B.C. 749 cal B.C. 687: cal B.C. 666 cal B.C. 641: cal B.C. 592	0.050921 0.69018 0.095115 0.163783
BS-1378 (1996-97), Trench No. U-19, L (6) (1.95-2.00 m)	2626 ± 110	cal B.C. 808: cal B.C. 536 cal B.C. 531: cal B.C. 522	0.977536 0.022464
BS-1299 (1995-96) (Pit sealed by L (6)	2914 ± 100	cal B.C. 1127: cal B.C. 893 cal B.C. 875: cal B.C. 848	0.92261 0.07739
BS-1300 (1995-96) L (6) (2.00 m)	3150 ± 110	cal B.C. 1436: cal B.C. 1190 cal B.C. 1178: cal B.C. 1159 cal B.C. 1144: cal B.C. 1131	0.909318 0.052302 0.03838

period) has been noted at Raja Nal-ka-Tila (RJN), District Sonbhadra (U.P.). Period I is characterised by the absence of metal and Period III contains NBPW. ^{14}C dates (Tewari *et al.* 2000) have been determined by two laboratories (Tables 2-3). There is some inconsistency in the dates from the BSIP. Dates from the upper levels are earlier than those from lower ones. The most probable reason for this inconsistency is human activity. Such problems are common in radiocarbon dates from many sites, and in such cases the excavators compute chronology with the integration of other evidence such as associated cultural material and stratigraphy. Fortunately, the dates from PRL are consistent and clearly indicate an early antiquity for the iron bearing deposits going back to cal B.C. 1431 – cal B.C. 1135 (PRL-2049). Two dates, determined by the BSIP (BS-1300: cal B.C. 1436 - cal B.C. 1131 and BS-1299: cal B.C. 1127 – cal B.C. 848) also correspond with them. Their stratigraphic position, associated pottery and their shapes, and the dates from the pre-iron bearing layers (PRL-2046: cal B.C. 1493 – cal B.C. 1265 and PRL-2045: cal B.C. 1629 – cal B.C. 1436) also corroborate this antiquity. Even the youngest date from the PRL-series (PRL-2047) is cal B.C. 1196-930, while the other begins from cal B.C. 1406. In view of these details, Mandal's arguments (2009: 3, 12-13) for treating all the dates from this site as inconsistent hold no ground.

Period I (layer 4 of Malhar, District Chandauli, U.P.), is characterised by the absence of metal, while Period II (layers (3) is marked by the presence of iron (Tewari *et al.* 2000). Four ^{14}C dates from this site (Table 4) show that BS-1614: cal B.C. 5475 – cal B.C. 5228 for a sample from a pit is out of context. The remaining three dates, BS- 1623: cal B.C. 1886 – cal B.C. 1643; BS- 1593 (from a pit sealed by layer (3) - cal B.C. 2010 – cal B.C. 1750, and BS-1590: cal B.C. 2283 – cal B.C. 2030 are consistent amongst themselves and in respect to stratigraphy. There is no gap between layers (3) and (4). Iron artefacts, slag and tuyeres appear from the lower levels of layer (3).[1] The associated ceramics include plain and painted Black-and-Red, black slipped, grey and red wares. Some potsherds bear cord impressions on their exterior surface. Notable shapes are dish/ bowl-on-stand, deep and shallow bowl, beaker, tumbler, and pedestal bowl. On the basis of consistent dates, stratigraphic position and associated cultural assemblage the antiquity of iron is placed in *c.* 18th-17th century cal B.C. at Malhar.

Mandal (2009: 4-5) considers all the ^{14}C dates from Malhar as inconsistent by singling them out one by one (from a series of four) and placing under the maxim "one date is no date." If we apply the maxim that 'one date is no date' to every site, almost every date may be declared as single and rejected. The details of the dates mentioned above demonstrate that only one date from this series, marked by us as 'out of context', is inconsistent. The remaining three dates are quite consistent in themselves, and in terms of stratigraphy and associated cultural material.

Table 4. Radiocarbon dates from Malhar (calibration of dates by B. Sekar)

Laboratory No.	^{14}C Dates in BP (Half life 5730 years)	Calibrated ages in B.C. One Sigma Ranges: [start: end]	Relative Area
BS- 1623 XA1, L. (3) – 55 cm	3550 ± 90	cal B.C. 1886: cal B.C. 1664 cal B.C. 1649: cal B.C. 1643	0.980346 0.019654
BS- 1614 A1 (Pit sealed by L (3)	6570 ± 110	cal B.C. 5475: cal B.C. 5293 cal B.C. 5256: cal B.C. 5228	0.903402 0.096598
BS- 1593 A1 (Pit sealed by L (3)	3650 ± 90	cal B.C. 2010: cal B.C. 2001 cal B.C. 1977: cal B.C. 1750	0.033556 0.966444
BS-1590 XA1, L. (4) – 80 cm	3850 ± 80	cal B.C. 2283: cal B.C. 2248 cal B.C. 2233: cal B.C. 2030	0.126395 0.873605

CALIB Radiocarbon Calibration Program (Copyright 1986-2010 by Stuiver and Reimer 1993) to be used in conjunction with Reimer *et al.* (2009)

Regarding the argument that the early date from Malhar might be the result of long-lived (500-1000 year's old) tree sample (Mandal 2009: 13), the following observation (Tewari 2003) has been wilfully overlooked: "the carbonised material dated from the sites mentioned above includes the branches of trees, such as *Acacia* sp., *Madhuca indica*, *Dalbergia sissoo*, *Trewia nudiflora*, *Boswellia serrata*, *Aegle marmelos*, *Syzygium sp.*, *Tectona grandis*, *Butea monosperma*, *Logerstroemia* sp., *Bambusaa* sp., etc., and the shrubs like *Ziziphus* sp., *Capparis sapiaria*, *Carissa opaca*. The above species are in mixed content, with the carbonised remains of leaves, stems and seeds of a number of seasonal herbs and grasses. This tropical vegetations generally has a 60-70 yrs average life span in case of trees, while the shrubs and herbs survive hardly from two to three months to a maximum one or two years."

Excavations at Jhusi, District Allahabad have revealed pre-NBPW iron bearing deposits comprising layers 45-52 (Misra *et al.* 2000). One ^{14}C date each for layers 46 and 49 is PRL 2075: cal B.C. 968 – cal B.C. 599 and PRL 2077: cal B.C. 1115 – cal B.C. 851. Considering cal B.C. date - 1107-844 for layer 49, layers 50 and 51 can reasonably be placed in 11th century B.C.

Excavations at Lahuradewa, District Sant Kabir Nagar, U.P., have revealed a five-period cultural sequence. A number of ^{14}C dates for different cultural periods have been determined by three different laboratories, i.e. BSIP, PRL and Erlangen University (Tewari *et al.* 2003, 2008). Iron artefacts present in Period III are in a highly corroded condition and are associated with plain and painted Black-and-Red, red, a thicker variety of black slipped, and grey wares. A radiocarbon date (BS-1939) consistent with stratigraphy and associated cultural material for this period is cal B.C. 1189-904.

Excavations at Narhan, District Gorakhpur, U.P., have revealed a five-period culture sequence (Singh 1994: 14-36). Period I, Narhan Culture, *c.* 1300-800 B.C., is characterized by painted Black-and-Red ware, Period II by black slipped and red wares (*c.* 800-600 B.C.), and Period III by NBPW. Two iron artefacts were found in the upper levels of Period I, dated c. 1000-800 B.C. (Singh 1991: 184; 1994: 18-19). In addition, a piece of burnt mud-plaster bearing a faint impression of a fish-hook with bits of rusted iron recovered from this period also attests to the use of iron in this period.

Recently, pre-NBPW deposit, Period I, at Aktha, District Varanasi, containing iron in the lowest levels along with Black-and-Red, black- slipped and red wares has been dated between *c.* B.C. 1800 and B.C. 1450 (Jayaswal 2009: 145) by ^{14}C dating.

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1. Asok Datta (2010: 311-12) has wrongly mentioned that iron has been found in a pit at Malhar and the earliest radiocarbon date for the same is 1800 B.C.

Eastern India (West Bengal and Bihar)

At excavated archaeological sites of West Bengal, iron appears from the lowest levels at Tulsipur, Mangalkot, Bahiri and Dihar (Datta 1995). At Baneswardunga, Hatigra, Bharatpur, Mahishdal and Pandurajardhibi iron is present in Period II, which precedes the NBPW.

The cultural assemblage revealed in the excavations at Tulsipur consists of two phases, both of which have Black-and-Red Ware, red and other wares. Phase II yielded black polished and grey polished pottery. Iron has been found throughout in both phases. (IAR 1967-68: 49-50)

The occupational deposits at Mangalkot are divided into six cultural periods, (Ray and Mukherjee 1992). The most important discovery of Period I (Chalcolithic) is evidence regarding the use of iron from the bottom layer. The iron artefacts include slag, ingots, arrowheads, points etc. Excavators have placed Period I between *c.* 1200-700 B.C. (IAR 1986-87: 111). The date, i.e. PRL-1358: cal B.C. 1111- cal B.C. 1103, cal B.C. 1076 - cal B.C. 1065, cal B.C. 1056 - cal B.C. 819 for the mid levels of Mangalkot Period I (Ray and Mukherjee 1992: 110).

The three-fold cultural-sequence of Bahiri is represented by BRW, early historic and structural phases. At Bahiri, in the upper levels of the Black-and-Red Ware phase, an extensive deposit of iron ore and slag could be traced for about 20 m. An extensive source of lateritic spread is about a km away from this site. The most important aspect of this site is the occurrence of a limited number of pieces of iron slag above the natural soil. Available radiocarbon date for the first phase at Bahiri is PRL-866 (Possehl and Rissman 1992: 463): cal B.C. 1189 - cal B.C. 1180, cal B.C. 1156: cal B.C. 1145, cal B.C. 1130: cal B.C. 795.

The earlier of the two cultural periods at Dihar is marked by the presence of Black-and-Red, red and black-slipped wares, including shapes such as the dish-on-stand, beaker, channel-spouted vessel, etc. The iron assemblage from Dihar includes spearheads, points, nails, circular object, chisels, slag and ore from the lowest levels.

Iron artefacts of Pandurajardhibi Period II date back to cal B.C. 1257 - cal B.C. 1234, cal B.C. 1217 - cal B.C. 895, cal B.C. 866 - cal B.C. 864 (PRL-1185, Possehl and Rissman 1992). Another ^{14}C date available for this period II (determined at Koln University of Germany) 2870 ± 50 BP (920 B.C.) (Ray and Mukharjee 1992: 15) correspond with the PRL date. The complexity of these tools indicates an earlier beginning of iron technology. Available date for the iron bearing deposit at Hatigra is cal B.C. 1212 - cal B.C. 901 (PRL-1191, Possehl and Rissman 1992).

It would be worthwhile to mention here that the finds from Barudih, District Singhbhum (Bihar) include an iron sickle in association of stone celts and coarse Black-and-Red Ware (Chakrabarti and Lahiri 1994: 21). The earliest available date for this phase is TF-1100: cal. B.C. 1410-830 (Possehl and Rissman 1992).

According to Datta (1995: 190) the beginning of iron technology in West Bengal can be traced back to *c.* 1200 B.C. However, considering the appearance of evolved artefacts and iron slag from the lowest layers, Chattopadhyay's opinion (1992: 212-13) that the beginning of iron technology in eastern India goes back much earlier to 1200 B.C. seems quite logical.

Technical Studies

Agrawal *et al.* (1985) carried out technical studies on iron implements including heavy arrowheads, swords, spears, etc., from megalithic sites of Karnataka. Some of them are as heavy as 1.5-2.0 kg in weight and as large as 178 cm in length. They believe that the types and numbers of iron artefacts from Tadkanhalli and Komarnhalli (contemporary to Hallur Period II and datable to *c.* 1200-1000 B.C.) show a developed iron technology, developing over at least a few centuries.

Discussion

Antiquity of Iron

The emphasis, on the basis of an expert's opinion, to rely only on conventional ^{14}C dates (Mandal 2009: 2) is apparently not convincing. This opinion (Agrawal and Kusumgar 1974) was submitted well over three decades ago, and, its application, as it is, in 2010 would be like putting the clock back. It may have been of some relevance during the seventies when the picture related to the use of calibration curves was obscure. In those days absolute ^{14}C dates were "probabilities" dependent on many uncertain factors in the system, human failures in collecting and recording data, and the reliability of fundamental assumptions on the nature of radioactive materials. Many archaeologists at that time (and I fear, some to this day) assumed that such scientific techniques must be either right or wrong, a success or failure, dependable or useless. Later, physicists learned much on the speculative and experimental nature of hard sciences. Radiometric dating is now refined and greatly improved in methods, so that far more precise dates can be determined, given adequate organic materials and taking into account several correction factors now known to be necessary. Now-a-days scholars in India and abroad, including experts quoted by Mandal, opt for the use of calibrated dates for greater precision. As viewed by Petrie (personal communication), there are no longer several calibration curves and it is very clear that there are dramatic variations in the quantity of ^{14}C in the atmosphere, implying that calibration is essential for achieving accurate dates. Therefore, there is no logic to adhere to the use of only conventional dates. The application of calibrated dates for iron bearing deposits at most sites has pushed back these dates well before the beginning of the 1st millennium B.C., fixed as a baseline for the antiquity of iron in 'India' by some scholars.

Arguments relying on factors such as the criteria used for interpreting consistent dates are well known to most field workers. Text book models are rarely found. Inconsistencies arising due to mixing of archaeological material, including charcoal, do occur at many sites. The reading and interpretation of inconsistent dates depend on theoretical knowledge, competence, and above all on the practical experience of respective investigators. If 'Sunga material occurs in Kushan levels and Kushan remains in the Sunga period,' it would apparently be a case of intermixing and would be considered in that perspective. This is the same when regarding radiocarbon dates. In such instances, inconsistent dates are rejected, and convincing evidence is incorporated. For example, regarding the Hallur ^{14}C dates TF-570 was rejected by Mandal because it was earlier than TF-573 and belonged to a lower layer (Mandal 1972: 38-40). However, the procedure of rejecting all determinations of a 'series of dates' on the basis of one or more inconsistent date/dates or due to other reasons has been adopted by the same scholar in the case of early iron bearing sites of Malhar, Raja Nala-ka-tila, Dadupur, etc. (Mandal 2009). Why were these double yardsticks applied?

As far as 'matching of the data with global profile is concerned,' we should not forget that many developments which happened in certain regions, which need not correlate with the beginning of similar events occurring in other parts of the world. One may ask, in this context, why pyramids were built in Egypt without any matching contemporary structures any where else, and, why the 'great wall' could be built in China without having contemporary parallels. There is no need to restate the fact that in archaeology one should be prepared for surprises and new discoveries. Before 1947, how many field workers imagined that so many Harappan sites would be brought to light in India in subsequent explorations? Around 1950, none of the sites dating back to the pre-NBPW phase were known in the Ganga Plain. At that point of time, none expected the discovery of hundreds of Mesolithic and pre-NBPW sites in this region. Therefore, it is unreasonable to reject the early dates of iron bearing deposits in India just because they do not fit with developments elsewhere.

Cultural Perspectives

The early date of iron in South Asia has greatly disturbed existing 'models' which postulated the introduction of iron into the Indian subcontinent from elsewhere in *c.* 1000 B.C. Regarding the Ganga Plains, this model revolves around the belief that 'thick forests in this area, which could be cleared with the iron artefacts around *c.* 700 B.C. with the arrival of migrants from the west along with horse and chariots comprising spoked- wheels. These migrants colonized the Middle Ganga basin on large scale. Before *c.* 700 B.C. there were very few settlements of the Black-and-Red and black slipped ware using people in the Middle Ganga Plain. Cultural deposits of these settlements in most of the cases were very thin or flimsy and at any rate in the alluvial tracts did not last for more than a hundred years or so. Real settlement by clearing the large territories and large scale agricultural activities started with the use of iron tools and implements, with the appearance of NBP during the age of Buddha. The references in the *Satapatha Brahman* and pre-Mauryan ancient literature and development of the Painted Grey Ware into Northern Black Polished ware or NBP were based to support this hypothesis. These changes on the main land of the Ganga Valley were sudden and occurred within a couple of centuries following socio-economic adaptation after the advent of iron,' and, so on. Subsequently the date for the introduction of iron in Ganga Plain, initially fixed by the followers of these views around 800-700 B.C., was modified to *c.* 1000 B.C. on the basis of conventional ^{14}C dates.

The main problem for the 'model,' mentioned above, came with the use of calibration for correcting ^{14}C dates, which have pushed back conventional ^{14}C dates from *c.* 1000 B.C. to *c.* 12th century B.C. A new series of much earlier dates going back to pre-1200 B.C. and to the early half of the 2nd millennium B.C. for iron bearing deposits from many areas of South Asia have highlighted this problem further. These factors taken together with the cultural and stratigraphic contexts make the above mentioned 'hypothesis' completely untenable.

The myth of dense forests in Ganga Plain prevailing from early 1950s (Tewari 2004) is no longer tenable. Palynological studies have shown that the Ganga Plain comprised a *savannah* type of landscape dominated by grasses, with wooden thickets at some places from the Early-Holocene onwards. The Ganga plain was hospitable enough to accommodate large settlements from millennia before the first millennium B.C. It was certainly sparsely inhabited during the earlier half of the Holocene period, but, the population and settlements began to increase during the 3rd and early 2nd millennium B.C. (Tewari 2010). Cultural sequences and thicknesses of cultural deposits (roughly 1.25–to over 5.00 m)[2] supported by radiocarbon and relative dating, attest to occupational deposits at most of the sites being neither 'thin' nor 'flimsy'; they cannot be dismissed as representing 'one or two centuries' of occupation. They demonstrate a clear case of continuous habitation in the middle Ganga Plain from the 3rd millennium B.C. on a considerably large scale.

Many excavated sites, comprising NBPW or contemporary deposits in the Middle Ganga Plain, contain pre-NBPW deposit/s as well, which shows that the demographic growth associated with the advent of NBPW is not entirely correct. In fact, it took place much earlier. The evolution of NBPW from black slipped and related wares in the Middle Ganga Plain is very plausible. At present, almost no one supports its evolution from the PGW.

Changes in the Ganga Valley were not 'sudden' at all. In the light of available evidence, the opinion regarding State formation in the Ganga Plain around 1500 B.C., on the basis of Pauranic genealogies, questioned by Sharma (1983: 106; 1998: xviii, 5) seems nearer the truth. Since the Middle Ganga plain forms a distinct geo-climatic unit, we should not expect to find all components, particularly monumental architecture made of stone and baked-brick, which contributed to the emergence of towns in western India. For a long time people lived in wooden and mud houses. The remnants of wooden structures, datable to *c.* 6th-7th centuries B.C. (IAR 1971-72: 82) onwards, recovered at Kankarbagh (Patna) and Rajghat (Varanasi), bear witness to this earlier tradition. States would have gradually evolved into *Janapadas* and *Mahajanapadas*, and towns into cities, by the time of the Buddha. Sharma (1998: 82) has aptly noted that 'the people who give much importance to the bricks and consider the construction of monumental building as characteristic feature of urbanisation, cannot visualise that towns emerged in the Middle Ganga Plain much before the arrival of baked bricks.' However, Sharma (1983: 106) believes that "the conjunction of literary and archaeological material indicates the advent of towns in the Middle Ganga plains around the sixth century B.C." But, looking at the cultural assemblage from the deposits datable to between *c.* 600 and 300 B.C. and those between 2nd and 3rd millennium B.C., we find no reason for restricting this period to *c.* 600 B.C. In view of the available archaeological evidence the arguments advanced by Sharma are equally well applicable to the period prior to *c.* 600 B.C.

The existence of sixteen Mahajanpadas and ten Ganatantras before *c.* 6th century B.C. in the Ganga Plain is clear proof of earlier developments. The presence of barley, wheat and pulses, capra, copper arrowheads (Ganeshwar type), steatite beads, dishes/bowls-on-stand with regional variation, developed black-and-red ware, spouted and pedestal vessels, terracotta tiles, *chauki* and earthen storage bins, from a number of sites, indicate contacts with distant places, most probably from the Harappan zone, during the 3rd and 2nd millennium B.C. (Tewari *et al.* 2008). The use of black-slipped, Black-and-Red, and other wares (fine textured, plain and painted) during this period, is also notable. Floral remains attest to the cultivation of almost all cereals and oil seed crops, like Indian mustard presently being grown in the Middle Ganga Plain,[3] before the advent of iron or during the period of its initial appearance (Saraswat 2005). The presence of spouted and decorated vessels seems to be related with some ritualistic practices. Beautifully made bone arrowheads bearing incised circlets provide a glimpse of contemporary craftsmanship. The size of some of these early settlements was considerably large (about 10 hectares at Lahuradewa) in terms of available elevated land. Their locations show deliberate site selection at naturally secure locales. So far listed habitation sites in the Middle Ganga Plain (around 260) and West Bengal (around 115)[4] during the 2nd millennium B.C., show considerable demographic growth. The evidence of jackfruit, grape, iron wood, teak, birch, *chharaila* and *putranjeeva* from the Middle Ganga Plain sites in pre-1000 B.C. context further attest to the developed way of life and long distance contacts (Saraswat 1993, 2004). By this time some plants of American origin, e.g. Custard apple (*Annona – Annona squamosa*), *Amaranthus* sp., Mexican poppy (*Argemone mexicana*) and some plants native to South-east Asia such as job's tear (*Coix lachryma-jobi*) also reached this area (Saraswat 1993: 39-40; 2004: 497-98, 510; 2007, Saraswat *et al.* 1994: 333-34).

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[2] For the precise thicknesses of the pre-NBPW deposits of the Middle Ganga Plain successive issues of IAR may be consulted.

If we go with an approach to ancient Indian literature that 'they convey ideas' (Eltsov 2008), Pauranic genealogies provide an essence of political activities going on during the period much before the advent of Buddha in the Ganga Plain. Taken together with the archaeological evidence, the probability for the existence of towns during second millennium B.C. is high. In view of the considerable number of early sites discovered in the Middle and Lower Ganga Valleys, external forces or migrants (as suggested by some scholars on the basis of the Videgh Mathava legend of the *Satapatha Brahmana*) should not be given disproportionate credit for the above developments in the first millennium B.C.[5] We do not mean to insist that these developments in the Ganga Plain were totally indigenous. Some external factors would also have contributed right from the early third millennium B.C. In short, we may observe that the process of these developments was already underway during the third and second millennium B.C. and its core had already taken shape well before *c.* 1000 B.C. What we observe around the 7th century B.C. is the culmination of the long drawn developmental processes. By this time, we find sixteen Mahajanpadas and ten Ganatantras fully in place in the Middle Ganga Plain.

The belief that PGW and Black-and-Red Ware were the main associated cultural components of iron in the Upper and Middle Ganga Plains, respectively, is misleading to some extent. At Noh and Jakhera iron has been found in pre-PGW contexts. At Dadupur it is associated with the characteristic dull red ware (with a few BRW sherds). In the Mid-Ganga Valley, it has been found with plain and painted Black-and-Red Ware and black slipped ware. The context of iron bearing deposits, in terms of antiquity and associated types of black-and-red ware, varies from the early half of the second millennium to B.C. 1000-800.

Conclusion

The data presented here demonstrates that iron appeared in South Asia during the earlier half of the 2nd millennium B.C. It has been found around 1300

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[3] It would be reasonable to recall Sharma's (1983: 93) inference regarding the use of iron ploughshares for the production of mustard. When mustard seeds were recovered at Narhan in pre-800 B.C. context, he ascribed them to a wild variety, and stated that at that time, they were not being cultivated (Sharma 1998: 18). Recently, Shrimali (2007: 14) has also echoed this view. Mustard belongs to genus *Brassica* and comprises 159 species, and is mostly native to the north temperate and Mediterranean regions of the Old World. Cultivation of mustard or field-brassica (*Brassica junea*) goes back to Harappan times. Its wild variety is not found in the Ganga Plain. The mustard seeds recovered from about half a dozen Middle Ganga Plain sites and dating to between 2000 and 800 B.C. (Saraswat 2005) are of the domesticated variety. Apparently, Sharma *et al.* labelled them wild to defend their views. Otherwise, this proves either the production of mustard in this region without the use of iron shares or it attests to the use of iron ploughshare during the early 2nd millennium B.C.

[4] The numbers of Black-and-Red Ware sites have been calculated on the basis of the reporting in the successive issues of the *Indian Archaeology: A Review* and publications of Datta (1995), Chakrabarti (2001) and Chattopadhyay *et al.* (2007).

B.C. at a number of sites securely dated on the basis of ^{14}C dates, stratigraphic context and associated cultural assemblages. With an increasing number of archaeological investigations, the number of sites furnishing iron objects during the last quarter of the 2nd millennium B.C. is also rising. An independent and early beginning of iron in the subcontinent is very clear. In the wake of the development of material culture, the beginning of iron-smelting must have been in vogue in the region much earlier than the appearance of iron tools.

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5. Regarding the interpretation of the 'Videgha Mathava' legend, the following observations are worth reproducing:

"In spite of the impression conveyed by some accounts (especially SB I.4.1.14 ff) that the area was only brought under plough by advancing 'Aryan' tribes, archaeological research has shown that it was well settled by the 2nd millennium B.C." (Erdosy 1995: 75)

"By the so called Chalcolithic period, datable to the mid-2nd millennium B.C. and identified by the presence of Black-and-Red ware in the Lower Ganga Valley and by Ochre Coloured pottery further west, there is a proliferation of settlements, even if central places continue to be absent. Clearly cultural evolution in the area did not await the 'Aryan' colonists of the Vedic texts. Nevertheless, the picture gleaned in one of very gradual evolution, even taking into account the infancy of research." Erdosy (1995: 76)

"The discovery of well-established village cultures based on the cultivation of two crops a year by rotation method in eastern UP and Bihar demonstrate an uninterrupted cultural continuity uninfluenced by any external stimuli from about *c.* 2000 B.C. in Bihar and from *c.* 1600 B.C. in the Saryaupar plain. This discovery has exploded the popular theory that this part of the country was 'aryanised' by clearing dense forests only around the eighth to seventh centuries B.C., as proposed by some scholars while giving a historical explanation of the Videgha Mathava legend of the *Satapatha Brahmana* (Singh 1999: 524).

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Megalithic Burials of Iron Age-Early Historic Kerala: An Overview

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Abstract

Archaeological surveys undertaken from 2006 to 2008 as part of Historical Atlas Project of South India revealed a number of Iron Age-Early Historic megalithic sites in the districts of Ernakulam, Idukki, Kannur, Kozhikode and Malapuram in Kerala. In addition, several previously reported archaeological sites were documented on the map using GIS. Based on the collected data, spatial and cultural patterning of archaeological and historical sites of Kerala was studied by the author. The paper presents an overview of Kerala megaliths and deals with the analysis of the megalithic burial monuments along with grave goods. A new typological system is also proposed for the megalithic burials of Kerala.

Introduction

Megalithism is a burial tradition of ancient South India, in which simple urn burials to complex, massive stone monuments commemorated the dead. The tradition of demarcating space for the dead away from living spaces, and constructing deliberate burials became common in the Iron Age across South India. The roots of this tradition date back to the Neolithic or perhaps to the Bronze Age, as known from burials at the Harappan site of Dholavira. However, this tradition, in one form or another, continued till the Early Historic period and in some areas even in the Medieval period, as known from the ^{14}C date of a cist burial (1200 CE) at Kunnoni in Kerala.

The Region

Kerala, (8° 17' N and 12° 47' N; 74° 00 E' and 77° 24' E) located on the southwestern part of India, is enclosed by the Arabian Sea on the west and the states of Tamil Nadu and Karnataka nestle it on the eastern and southern and northern sides respectively. Kerala has a 580 km long coastline extending from Kasaragode in the north to Tiruvanathapuram in the south. With an area of more than 38,000 km^2, the region is divided into three physiographic zones, namely, highland, midland and lowland. Highlands are predominantly of granite and lie above 76 m AMSL. The midland, of laterite, lies between 7.6 and 76 m, and lowlands with sandy coastal deposits and alluvium lies between below 7.6 m (Velu Pillai 1940). The 44 rivers that flow in the region make it verdant and nature's favourite; the Periyar and the Ponnani are major rivers. Kerala is blessed with 34 backwaters bodies, which along with the rivers provide vital links to the inland and coastal regions. The region is characterised by excessive rainfall with an intermittent hot climate. It is vital to recognize that the special geo-physical conditions of the region, distinct from other parts of South India, played a decisive role in the formation of its cultural identity (George 1975; Rajendran 1989).

Megaliths of Kerala

South Indian megalithic burials were built largely according to local geology. The most common burial types of Kerala are urns, cists, dolmens, and menhirs. Umbrella Stones (hereafter, US), hat stones, hood stones, and rock cut caves (hereafter, RCC) mostly influenced by the preponderance of laterite formations are mainly confined to Kerala. Most burials are associated with grave goods such as ceramics (Red ware, coarse Red ware, Black ware, Black-and-Red ware pottery) along with iron implements and etched carnelian beads, bronze artefacts and russet coated painted ware, in some cases perhaps of the Early Historic period. Recent research on megalithic sites by the author, as part of the *Historical Atlas of South India*, revealed that Kerala has more than 850 known burial sites. There may be more sites buried, and many already destroyed without any documentation.

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Many burial sites have been brought to light due to construction, agriculture and other developmental activities. Megalithic monuments have endured the onslaught of natural and human agencies for many centuries and some of them still remain as prominent features on the landscape perhaps due to local beliefs on their sacred associations.

Studies on Megaliths in Kerala: An Outline

Archaeological research in Kerala started with the discovery, excavation and publication of a burial site at Chattaparamba in Kozhikode district in Northern Kerala by John Babington as early as 1819 (Babington 1823). Interestingly this appears to be the first published report of an excavated site in India. Though Colonel Colin Mackenzie noticed megalithic burials even before Babington in South India, they remain unpublished. Only the Mackenzie manuscripts are available (Paddayya 2006). Archaeological discoveries in Kerala made by British and Indian scholars were not as varied as found in other parts of India. However, antiquarians such as Logan (1879, 1887), Fawcett (1890), Sewell (1882), Walhouse (1882), Longhurst (1911-12) Dubreuil (1922), Joseph (1928) Cammiade (1930), Plenderleith (1930), Codrington (1930) and Aiyappan (1933) have contributed immensely to the understanding of Kerala's archaeological past through explorations, excavation and publication of results (Darsana, 2006, 2007, 2008, 2009).

Government institutions such as the State Department of Archaeology and the Archaeological Survey of India (ASI) have explored and excavated a few megalithic burial sites of Iron Age-Early Historic Period such as Porkalam, Mangadu and Cheramangadu. The excavation of urn burials at Porkalam by B.K. Thapar in 1948, helped in assigning a tentative chronology of this culture ranging from the 3rd century CE to the 1st century BCE. This chronology was arrived at on the basis of the occurrence of etched carnelian beads which were compared with other sites and with Brahamagiri excavated by Wheeler (1947-48). Thus, this is tentative in nature (Thapar 1952: 6).

Anujan Achcan, (head of the State Department of Archaeology) helped Krishnaswami (1949) in the survey of megaliths, which resulted in a comprehensive typology for the burials. Ambiguity surrounding the rock cut cave, a unique burial type of Kerala was cleared in Sharma's (1956) study of rock cut caves in Cochin region. Rock cut caves were earlier considered to be the huts of hermits or of a dwarf race; but were subsequently proved to be megalithic burials.

More than 20 megalithic sites were excavated in the second quarter of the 20th century, but many of them were salvage operations (John 1974, 1982; Raghavan and Devasahayam 1974; Raman 1976). George's work on the archaeological and historical aspects of the region, the first doctoral dissertation on Kerala archaeology, provides valuable information on megalithic monuments of Kerala. The spade work done at Machad-Pazhayannur by Mehta and George (1978) is significant for the scientific analysis of iron objects found in the megalithic burial.

Mangad excavation by Satyamurthy (1992) provided an early date for megaliths in Kerala (i.e 1000 BCE by ^{14}C dating). Excavations by Rajendran (2005) of a cist burial at Oliyani (Kunnoni) yielded a ^{14}C dating of 1200 CE[1] thus demonstrating that the megaliths are a part of the tradition that perhaps began in the early first millennium BCE and continued in the historical period as well.

Research in the Periyar-Ponnani river Valleys by Chedambath (1997) was regional in scope and it added information on megalithic burials through a salvage excavation at Kurumasserry. A synthesis of Kerala megaliths was done through collection of available data by Jenee Peter (2002). New anthropological models were introduced and tested in the Palakkad region by Abraham (2002), who analysed inter-site and intra-site variability and ceramic assemblages. Research on megaliths at Kasaragode (Nair 2005, 2007) sought to understand burials as markers in their landscape context. The excavation of a rock cut cave at Ummichi Poyil, Kasaragode by the Archaeological Survey of India opened an interesting debate on the megaliths of northern Kerala (http://asi.nic.in/asi_exca_2005_kerala; Nair 2007).

The excavation of the early historical site of Pattanam (presumably Muziris of the Classical Greco-Roman and Tamil literature) with Roman contacts, provided evidence for the habitation of the Iron Age-Early Historic transition (Shajan *et al.* 2004; Cherian *et al.* 2009) for the first time in Kerala.

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[1] Elsewhere, inadvertently the dating has been mentioned as TL dating (Darsana 2009)

Table 1. List of megalithic burial sites explored during 2006-2008

Place/Site	**District**	**Longitute**	**Latitude**	**Burial**
Chinnapparakudi	Idukki	76° 56' 16. 2"	10° 0' 24"	cist
Muniara/Vellathuval-II	Idukki	77° 1' 26.2"	9° 59' 9.4"	cist
Kuthupara II II	Idukki	77° 1' 55.9"	9° 59' 25.2"	cist
Kambilikandam	Idukki	77° 0' 51.6"	9°56'59.9"	cist
Pannikan Kudi	Idukki	77°4'1.7"	9° 55' 38.6"	cist
Pallicity, Ponmudi	Idukki	77° 2' 36.3'	9° 57' 37.4"	cist
Kunnoni	Kottayam	76° 50' 5.1"	9° 39' 21.5"	cist
Kavungumprayar	Pattanamthitta	76° 39' 27.7"	9° 23' 38.9"	cist
Kuttampuzha	Ernakulam	76° 43' 52.3"	10° 8' 57.3"	dolmen
Pandavan Koil, Sing kandam	Idukki	77° 12' 20.2"	10°.2' 23.3"	dolmen
Shanmughavilasam Adivasi colony	Idukki	77° 12' 53.4"	10° 2' 29.5"	dolmen
Tenmala Rehabilitation Plantation Ltd	Kollam	77°3'7.8"	8°57'24"	menhir
Choondangappoyil-Palerikadu Parambu	Kannur	75° 32' 52.1"	11° 46' 21"	rock cut cave
Ponnium-Chamblontavide	Kannur	75° 31' 57"	11° 46' 37.4"	rock cut cave
Meleppookam-	Kannur	75° 34' 38.6"	11° 45' 0.7"	rock cut cave
Mooriyad-Moravelicham	Kannur	75° 35' 50.1"	11° 49' 36.9"	rock cut cave
Thodikalam	Kannur	75° 39' 12.9"	11°51'21.9"	rock cut cave
Thodikalam Varrierveedu	Kannur	75° 39' 17.8"	11°51'21.6"	rock cut cave
Kapporiryalil	Kannur	75° 39' 28.7"	11°51'47.5"	rock cut cave
Kannavam Forest	Kannur	75° 39' 56.4"	11°50'8"	rock cut cave
Nittampu (Maloor)	Kannur	75° 38' 42"	11° 52' 58.8"	rock cut cave
Sivapuram-Alattumkadu	Kannur	75° 36' 43.01"	11° 54' 39"	rock cut cave
Sivapuram-Madappurakundam	Kannur	75° 36' 11.09"	11° 54' 36.9"	rock cut cave
Mampoil	Kozhikode	75° 46' 24"	11° 26' 38"	rock cut cave
Pavandoor	Kozhikode	75° 48' 18"	11° 23' 18"	rock cut cave
Menoki road	Kozhikode	75° 51' 58'	11° 13' 15"	rock cut cave
Pythothu II	Kozhikode	75° 46' 29"	11° 34" 23"	rock cut cave
Cheriyeri	Kozhikode	75°43'44"	11°33'49"	rock cut cave
Pullukunnu	Malappuram	75°53'12.4"	11°10'26.1"	rock cut cave
Kuthukallu (Ananthavoor)	Malappuram	75° 58' 57"	10°53'18.3"	rock cut cave
Atholi I	Kozhikode	75° 45' 45"	11° 23' 45"	rock cut cave, umbrella stone
Chennikulam dam site	Idukki	77° 1' 4.6"	10° 02' 2.3"	stone alignment
Adivasi Colony	Idukki	77° 12' 10.2"	9° 58' 21.7"	stone alignment
Mullanthanadu	Idukki	77° 11' 39"	9° 59' 16.4"	stone alignment

Place/Site	**District**	**Longitute**	**Latitude**	**Burial**
Chinnakkanal II	Idukki	77° 11' 2.3"	10° 2' 44.6"	stone alignment
Pythothu I	Kozhikode	75° 46' 46"	11° 34' 31"	umbrella stone
Naduvallur	Kozhikode	75° 48' 50"	11° 23' 33"	umbrella stone
Kodakuthiyil	Kozhikode	75° 43' 23"	11° 33' 31"	umbrella stone
Puthukod	Malappuram	75° 52' 56.8"	11° 11' 45.8"	umbrella stone
Thennala-Kudakkal	Malappuram	75°56'1.6"	11°0'40.8"	umbrella stone
Koloorppalam	Malappuram	75° 56' 57"	10° 52' 47.2"	umbrella stone
Thaneerkodu-Thozhukara	Palakkad	76° 4' 42.2"	10° 46' 39.2"	umbrella stone
Anthyalamkavu	Malappuram	75°59'15.3"	10° 50' 21.7"	umbrella stone and urn
Thavanur-Kakkasserikunnu	Malappuram	75° 58' 21.6"	10° 50' 49.3"	umbrella stone and urn
Kakkoor	Kozhikode	75° 48' 42"	11° 23' 6"	urn
Kuthupara I	Idukki	77° 1' 57.9"	9° 59' 24.3"	urn
Uluthuvayil	Kottayam	76°31'6.4"	9° 37 '0"	urn
Pavumpa Junction	Kollam	76° 53' 23.5"	9° 3' 42"	urn
Kokkadu	Kollam	76° 52' 7.9"	8° 58' 48.7"	urn
Eroor	Kollam	76°56'31.9"	8°55'59.2"	urn
Koovakad2	Kollam	77° 2' 13.7"	8° 57' 0.4"	urn
Konni	Pattanamthitta	76° 50' 53.1"	9° 13' 40.1"	urn
Kaanjur	Ernakulam	76° 26' 42"	10° 10' 3"	urn
Pallarimangalam	Ernakulam	76° 39' 37.2"	10° 1'3 9.7"	urn
Pattimattam	Ernakulam	76° 26' 37.7'	10° 1' 37.7"	urn

This is the only habitation site of the Iron Age-Early Historic megalithic culture to be excavated in Kerala. In 2008, burials at Anakkara were excavated by a team from the School of Social Science, Mahatma Gandhi University (Gurukkal *et al.* nd). Interestingly, the site yielded evidence of a stone quarry for raw material for the burials.

Socio-economic formations of the Iron Age society have been studied in Gurukkal and Varier's *Cultural History of Kerala (1999)* where settlement and natural processes involved in megalithic burial culture are discussed.

Elements of megaliths are seen in funerary customs in Kerala. A pioneering attempt to study this was made by Iyer (1967). In recent years, a few preliminary attempts have been made to study customs of the Cholanaickans of the Nilambur forest region in Malappuram district (Ajit Kumar 2007; Poyil 2007).

Analysis of Megaliths of Kerala

The Historical Atlas of South India is a collaborative project of the French Institute, Pondicherry, the Mahatma Gandhi University and various universities of South India and supported by the Ford Foundation. It is an attempt to prepare a digital atlas of archaeological sites of South India (http://www.ifpindia.org/histatlas/). During this survey, only limited field work was undertaken for locating new sites. The Kerala team extensively surveyed the region and brought to light existing and new sites and monuments (Table 1). Based on fieldwork and published data more than 800 megalithic sites have been listed so far (Table 2). However, data on the sites is not complete as the terrains of Alappuzha, Pathanamthitta, Kasaragode, Kottayam, Wayanad and Idukki, have not been surveyed completely. (Based on Historical Atlas project data 2005-2008)

Out of 866 sites listed, nearly 66% sites have single burial types, while 34% have multiple burial types, where more than one type of burials occurs (Table 2). Out of the 34% multiple burial type sites, one third (11%) are in Palakkad, a distinct ecological region, probably due to the fact that the region witnessed extensive field surveys. The distribution of burial types in various zones of Kerala is given in Table 3.

From Table 2, it is amply clear that urns and dolmens are found throughout Kerala. They have not been noticed so far in the northern-most region of Kasaragode. Perhaps, an intensive survey might reveal urns in this region. Strangely, cists occur in all zones of Kerala, with a solitary one found in Kasaragode. However, the excavation of this burial type is limited to six sites. Unique types such as hood stones, hat stones and umbrella stones are restricted to a few regions of Kerala, as the architecture of the burials requires lateritic rocky outcrops.

It is significant to note that only around 38 sites have been excavated, a mere 0.04% of total known sites of 866 (Table 4). Out of 38 sites, 9 sites have been dug by antiquarians, 7 have been excavated by the ASI, 11 by educational institutions, and 11 by the Kerala State Department of Archaeology. In addition, there are a number of salvage excavations by researchers and curious individuals. Interestingly, the sites that have been excavated by antiquarians provide more information than sites that were opened in the post-independence period. This can be attributed to better documentary skills and interests of the antiquarians. Among them, only a handful of sites have detailed published accounts of the burials (Porkalam, Mangadu, Machad and Pazhayannur). It is regrettable that only meagre information in bits and pieces is available for all other sites. The burials although a much studied aspect in Kerala archaeology, were never put to analytical and technological investigations save for those at Machad and Pazhayanur (Mehta and George 1978). Apart from burials that are excavated, quite a few burials have been opened accidentally or for salvage operations by educational institutions or by the public, for which very little or no systematic data is available. Only excavated sites that provide some basic information are discussed here.

Table 2: Number of burial sites in Kerala of Iron Age Early Historic Period

District	**Single Burial type**	**Multiple Burial Types**	**Total**
Alappuzha	4	3	7
Ernakulam	48	11	59
Idukki	29	31	60
Kannur	91	11	102
Kasaragode	28	7	35
Kollam	30	10	40
Kottayam	18	7	25
Kozhikode	73	25	98
Malapuram	78	22	100
Palakkad	63	101	164
Pathanamthitta	10	6	16
Thrissur	93	42	135
	8	5	13
Wayanad	6	6	12
Total	**579**	**287**	**866**

Availability of raw material is one of the factors guiding megalith builders in choosing burial types. However, this factor alone did not restrict them from experimenting with or choosing various forms of burials and some of the types are unique to this region. It appears that there is some social significance for choosing a particular burial type.

As urns are commonly found, they have been excavated to a great extent, followed by RCC. More than 50% of the excavated rock cut caves were opened by antiquarians in the pre-Independence period. It is strange that the 'bun-shaped' *topikkal* (2) and mushroom shaped Kudakkal (3), which are unique to this region saw the least spade work (Fig.1).

Despite the existence of numerous burials, only one habitation site of this period has been identified. In Pattanam, essentially an Early Historic port town with Roman contacts, the lowermost strata

Table 3: District wise distribution of burial types

	Types of Burials							
District	**Urn**	**Cist**	**Dolmen**	**Menhir**	**Rcc**	**Us**	**Hat Stone**	**Misc.**
Alappuzha	P	P	P	A	A	A	A	A
Ernakulam	P	P	P	P	P	A	A	A
Idukki	P	P	P	P	A	A	A	P
Kannur	P	P	P	P	P	P	A	A
Kasaragode	A	P(1)	A	A	P	P	A	A
Kollam	P	P	P	P	A	A	A	A
Kottayam	P	P	P	P	P	A	A	A
Kozhikode	P	P	P	P	P	P	A	P
Malapuram	P	P	P	P	P	P	A	P
Palakkad	P	P	P	P	P	P	P	P
Pattanamthitta	P	P	P	A	P	A	A	A
Thiruvanathpuram	P	P	P	P	A	A	A	A
Thrissur	P	P	P	P	P	P	P	P
Wayanad	P	P	P	P	P	A	A	A

A: Absent P: Present RCC: Rock cut Cave; US: Umbrella Stone

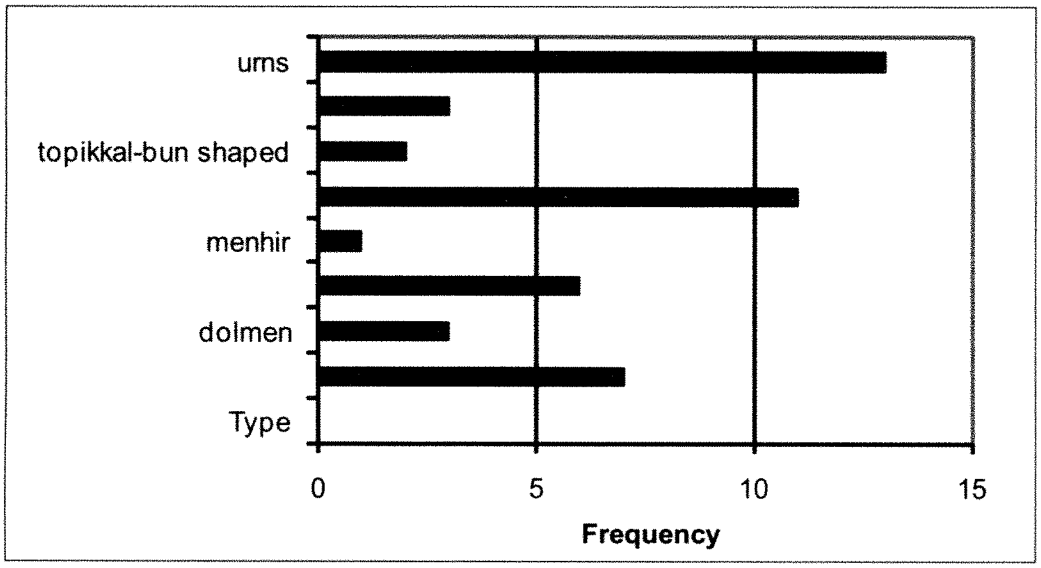

Fig. 1: Excavated burials in Kerala

yields Iron Age-Early Historic transition layers with characteristic pottery such as Black and Red ware and Coarse Red ware. Here too, the Iron Age Megalithic evidence is scanty. AMS dating of this layer fixes the chronology of the Iron Age- Early historic transition to the first half of the first millennium BCE (Cherian *et al.* 2009: 324-325).

Burial Typology

The complexity of the structure of the burial monuments poses problems in defining their typology. Many scholars have attempted to build a typology right from the antiquarians, who label the burials as barrows, cromlechs and kistavens. Krishnaswamy (1949) made a preliminary attempt

Table 4: List of excavated Megalithic burial sites of Iron Age-Early Historic Period*

Name		District	Type of Burial	Terrain	Reference
Puliyur	1991	Alappuzha	Cist	granite	Satyamurti 1992
Kunnukara	1996	Ernakulam	Urn	laterite	IAR 1996-97:56-57
Kurumasserry	1997	Ernakulam	Urn	laterite	Chedambath 1997
Mekkalady	2006	Ernakulam	Urn	Laterite	Selvakumar 2006
Periakanal	1938	Idukki	Dolmen	granite	Satyamurti 1992; ARASI 1938-39
Tengakkal	1967	Idukki	Cist	granite	L.A. Krishna Iyer 1967
Bison Valley	1967	Idukki	Dolmen	granite	L.A. Krishna Iyer 1967
Thondimala	1967	Idukki	Dolmen	granite	L.A. Krishna Iyer 1967
Marayur	1967	Idukki	Menhir	granite	L.A. Krishna Iyer 1967
Velimala	1967	Idukki	Urn	granite	L.A. Krishna Iyer 1967:20
Peringalam	1910	Kannur	Rcc	laterite	Rea 1910-11
Chitrari	1974	Kannur	Rcc	laterite	John 1974
Punnol	1974	Kannur	Rcc	laterite	Raghavan and Devasahayam 1974
Panunda	1974	Kannur	Rcc	laterite	Raghavan and Devasahayam 1974
Naduvil	1991	Kannur	Rcc	laterite	John (nd) excavated in 1991; Nambiar 1995
Ummichipoyil	2004		Rcc	laterite	Jayashree 2007
Mangadu	1992	Kollam	Urn (Stone Circle)	granite	Satyamurthi 1992
Poredam	1993	Kollam	Urn	laterite	Rajendran and Kshirsagar 1993
Arippa	1997	Kollam	Cist	Granite	Rajendran and Iyer 1997
Kunnoni	2005	Kollam	Cist	granite	Rajendran 2005
Chatta Paramba	1819	Kozhikode	Bun Shaped *Topikkal*	laterite and granite	Babington 1823
Challil Kurunoyil	1879	Kozhikode	Rcc	laterite	Logan 1879
Calicut	1890	Kozhikode	Rcc	laterite	Fawcett 1890
Malaparamba	1911	Kozhikode	Rcc	laterite	Longhurst 1911-12
Feroke	1933	Kozhikode	Rcc	laterite	Aiyappan 1933
Pazhukkaliparamba	1936	Kozhikode	Rcc	laterite	Satyamurthi 1992; ARASI 1936-37
Perambra	1982	Kozhikode	Mushroom shaped *Kodakkal*	laterite	John 1982
Tiruvilvamala	1937	Palakkad	Cist	granite	Govinda Menon 1937
Anakkara 1	2008	Palakkad	Mushroom shaped *Kodakkal*	Laterite and granite	Gurukkal *et al* n.d
Anakkara 2	2008	Palakkad	Multiple Hood Stone	Laterite and granite	Gurukkal *et al* n.d
Porkalam	1948	Thrissur	Urn	laterite	Thapar 1952
Pazhayanur	1978	Thrissur	Cist	laterite	Mehta and George 1978
Machad 1	1978	Thrissur	Cist	laterite	Mehta and George 1978

Name		District	Type of Burial	Terrain	Reference
Machad 2	1978	Thrissur	Urn	laterite	Mehta and George 1978
Cheramangad V-A	1990	Thrissur	Urn in a Pit	granite and laterite	IAR 1990-91
Cheramangad V-B	1990	Thrissur	Urn in a Pit	granite and laterite	IAR 1990-91
Cheramangad V-C	1990	Thrissur	Urn in a Pit	granite and laterite	IAR 1990-91
Cheramangad II	1990	Thrissur	Multiple Hood Stone	laterite	IAR 1990-91
Cheramangad I	1990	Thrissur	Hood Stone	laterite	IAR 1990-91
Cheramangad IV	1990	Thrissur	Bun Shaped *Topikkal*	laterite	IAR 1990-91
Cheramangad III	1990	Thrissur	Mushroom shaped *Kodakkal*	laterite	IAR 1990-91
Kaniyambetta-Minangadi road	1930	Wayanad	Urn	granite	Cammiade 1930
Kandathamvayil	1930	Wayanad	Urn	granite	Cammiade 1930
Puthupadi	1930	Wayanad	Urn	granite	Cammiade 1930
Sultan Battery	1930	Wayanad	Urn	granite	Cammiade 1930
Kaniyambetta Traveller's bungalow	1930	Wayanad	Urn	granite	Cammiade 1930

(*The list includes scientifically excavated sites, salvage digging and burials opened by antiquarians. Though only 38 sites are excavated, three of them (Cheramangad, Machad and Anakkara) have more than one type of burial excavated. Due to lack of information, some of the excavated sites are not included)

Table 5: Megalithic burial typology

Type	Characteristic features	Visibility
Type 1	Urns without visible lithic appendages	Buried component invisible
Type 2	Megalithic burials essentially above the ground- Dolmens, Kudakkal (mushroom shaped umbrella stones) and *Topikkal* (bun-shaped hat stones) and Hood stones	Clearly visible and the subsurface burial is not visible
Type 3	Megalithic burial under the ground- Cists and Rock Cut Caves	Invisible

to classify the burials. The burial typology discussed in Gurukkal and Varier (1999) lacks data in many respects. Based on the architecture of the burials, the following categorization is proposed. The availability and suitability of rock formations for building various types of burials is a significant factor in classifying the monuments. The visibility of the burials on the landscape also plays a vital role in the typology. On the basis of these criteria, the following typology is proposed (Table 5)

Type 1 consists of urns, which might have survived from the Neolithic period onwards. The pit burial, one of the primitive types for disposing the dead, was transformed into an urn in later years. They may be without lithic appendages that give the name 'megalithic' to the burial tradition. However, they share the same cultural traits of other megalithic burial monuments. These could be the earliest burial type to start with, but continued in the later period as well.

Type 2 consists of those burials that are truly megalithic, that is made of huge stones. They are visible clearly on the landscape. Dolmens, menhirs, *kudakkal* and *topikkal* and hoodstones fall under this category. At times, dolmens are partially buried under the ground and they go by the name of dolmenoid cist. However, they are grouped in type 2 category, for most of them are found above the ground. These burials have two main features:- a. above surface visibility; and b. sub surface burials- (the real burial may not be visible and contains the burial relics in urns or sarcophagus). The umbrella stone made of laterite rock is actually a variant of the dolmen, which is usually made of granite. Cultural exchange

Table 6: Burial Types in eco-zones

Granite	Laterite
Dolmens	Umbrella stones-mushroom shaped
Cists	Rock cut caves
Stone circles	Multiple Hood stone
Urns (Covering lids)	Urns (Covering slabs)

between various groups in different eco-zones would have promoted new varieties that befit the local environmental conditions. It is important to note that urns and sometimes sarcophagi are noticed below these visible stone markers. The menhir is usually commemorative in nature except at a few places. Under these megaliths, mortal remains are found in pits, urns or sarcophagi. At times, they are also commemorative. One needs to excavate more burial sites in Kerala to bring to light the true nature of the burials - whether funerary or commemorative. Currently most of them appear to be secondary and funerary.

Type 3 consists of those burials that are built below the ground, using stones. Though they are also megalithic in nature, they are not visible on the landscape like burials in Type 2. The cist is actually a variant of the dolmen, which is erected above the ground. However, the main difference is that cists with four orthostats and a top slab are built by digging a huge pit in the soil or in a granitic rock formation. The Rock Cut cave, a unique type found in the laterite zone of Kerala can be treated as a variant of a cist underground. The grouping based on the nature of stone and similarity of the burial architecture would reveal similarity between burials. Out of the major six types of burials, the types that occur in the granite zone have a corresponding type in the lateritic zone (Table 6).

Out of the 46 excavated burials, more than 50% fall in the laterite zone and less than 15% of burials used both lateritic and granitic rocks (Fig. 2). The burial types such as RCC, umbrella stones (mushroom-shaped), hat stones (bun shaped), and hood stones occur mainly in the laterite zone, while types such as dolmens, cists, and menhirs occur in granite outcrops. Urns occur in both zones.

Dolmen, a table like structure made of four upright orthostats built above the ground becomes an umbrella stone with four or more clinostats if laterite is used. Due to the very nature of the lateritic rock, all the clinostats are joined together and a top slab was placed, as in the dolmen. Therefore, the umbrella stone is an elaboration of a dolmen. Similarly, the cist built under the ground has a porthole; and the corresponding type of rock cut cave built below the surface has an opening in the top. It is observed by some scholars as early as Logan (1887: 180) that rock cut cave is a variant of the cist, which is usually made of granite. Wherever the raw material does not suit the construction of cist burials, the megalithic population resorted to building the rock cut cave from easily carved laterite. The stone circles that mark the burial which are common in granite zone are built as multiple hood stones in the lateritic zone, below which one finds burial urns. Out of the six hood stone burials excavated in Kerala, only one did not yield any grave goods, while all others have yielded urns in pits. The hood stones are not frequent.

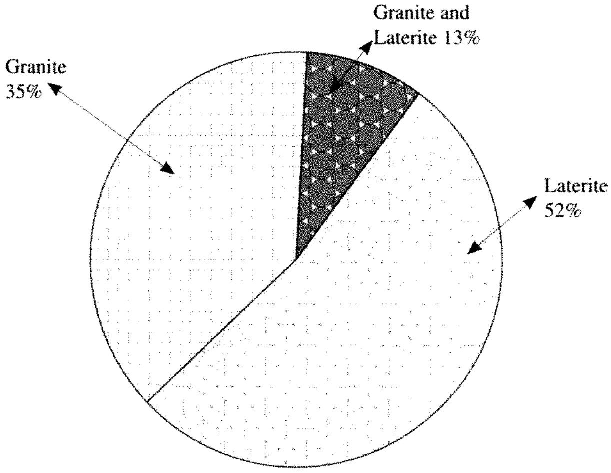

Fig. 2: Number of Burials in Different Rock Formations

Type 1

Urns (*Nannangadi*)

The simplest method of burying the dead was by placing select mortal remains or symbolic internments in a huge urn. This is commonly noticed in Kerala. The primitive pit burials appear to give way to urns with a pointed end. The urn might have signified a womb symbolizing the return to a new world or rebirth (Logan 1887). By burying the dead with necessary grave goods, ancient people might have believed in the safe passage of the soul to the next world or probably in rebirth.

Logan based on observations of a hole found at the bottom of the urns from Vaniamkulam, Valluvanad Taluk in Palakkad district made a symbolic link of the urn with the mother earth-'Bhudevi'. He stated that the protuberance in the urn signifies the '*os uteri*' and is 'emblematic of the return of the individuals to the womb of mother earth' (1887:182).

The urns, known as *nannangadis* in Malayalam occupy the fourth largest type in Kerala. The concentration of urn burials is more in the lowland coastal zone. With the exception of the high land zone of Kasaragode, urns are noticed everywhere. Interestingly, urns are found more as single type burials (73%) and 27% of urns is found along with other types of burials such as cists, dolmens, RCC and menhirs. Urns are usually made of low quality red ware and they are huge enough to accommodate skeletal remains, in most cases, it is secondary in nature. At times, the urns are covered with stone slabs and sometimes marked with stone and cairn circles. In some cases, they are found within the rock cut caves, umbrella stones and hood stones with surface markers.

Type 2

a. Dolmens (*muniyara, chamber of sages*)

The dolmen is a variant of a cist which looks like a table. Usually found above the surface, dolmens are made of orthostats with a porthole or a circular opening on one side. As many as 92% dolmen sites belong to multiple burial types, and only 8% are single burial type sites. Perhaps in the single sites, other burials could have existed and have disappeared due to natural vagaries. They are distributed throughout Kerala except, interestingly, in the highland of Kasaragode, where their absence can be attributed to lack of intensive survey. Probably, the umbrella stone or *kodakkal*, a variant of dolmen was constructed in these zones.

b. Menhirs (*Nattukkal/ Pullachikkal*)

Menhirs are made of single stones. They are erected sometimes over the relics of dead people, and are devoid of any grave goods placed beneath them. At places they are found in alignment as noticed at Idukki region. Both single and multiple sites are more or less the same with 52% and 48%, respectively, indicating that there is no unique distribution of this type of burial. They are found in lateritic and granitic formations.

c. Umbrella stones (*Kudakkallu*)

Umbrella stones form a unique type of burial in Kerala. Made of laterite, they have four clinostats over which rests a huge cap stone (Fig. 3, see cover page 2). The shape of the entire structure resembles a mushroom[2]. Babington calls it *topikkal* and not as *kudakkallu*. But in modern parlance, scholars call it *kudakkallu*. As dolmens are found in the granitic zone, they could not be made from laterites. Hence, megalithic people could have designed this type, (similar to the granite dolmen) in the form of a mushroom in laterite, where the four orthostats of the dolmen join together as clinostats to take the central slab. It is pertinent to note that iron implements and charred bones found in dolmens are not found associated with umbrella stones, with the exception of Anakkara (Gurukkal *et al.* nd). A rare transition type is seen at Paraladakkam, Kasaragode. They are found concentrated in the lateritic zone and nearly 62% of sites are single sites and 38% are multiple sites.

d. Hat stones and other types

At 3% sites we noted miscellaneous types such as hoodstones, hat stones, stone alignments and stone circles. They generally occur along with other burial groups. The stone burials that Babington (1823) noticed at Chathaparamba, Kozhikode are umbrella stones (*Kodakkal* or '*kodey kull*') and hat stones (*Topikkal)* (Fig. 4, see cover page 2). In some works, hat stones are referred to as capstones, the term usually used for denoting the sealing stone of a burial (Gurukkal and Varier 1999:116-117). Leshnik refers to the '*topikkals*' as hood stones (1974).

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[2] It is not out of context to note that these umbrella stones are associated with the analysis of pshycoactive mushrooms, especially fly agaric which "allowed visions of the "other side", of life after death; as such they were far more suitable than others (than edible mushrooms) to being associated with funeral cults" (Samorini 2001:263). Manilal (1981) argued that some of the mushrooms contain hallucinogenic chemical compounds and the tribals who eat them, treat them with reverence and fear. The tribes believe that the mushroom contain mysterious powers that can help them communicate with the dead. It has been proposed that mushroom shaped burials were built in the early period in reverence and respect for the dead, as well as to the mysterious power of the mushrooms. A similar attempt is seen in the works of Borgheyi who connected the mushroom shaped stones used by Mexicans to rituals for dead ancestors (John 1982:152)

However, Babington (1823: 324) clearly explained that the *'kodey kull'* derived its name from its very shape that is "like the umbrella or chettery in common use among the natives". He further elaborated that in the term *Kodey kull,* "the first word signifies a *chattery* in Malabar and the last a stone." The *topi kull* on the other hand has "a strong resemblance to a mushroom." However, in modern literature, terms used for these burials types were reversed. The burial monument with a huge stone atop, the three or more support stones (clinostats) is known as an umbrella stone and the one without any base (clinostats) is called 'hat stone' in modern parlance. Below the hat stone, one finds urns. The confusion arose because scholars of the late 20th century were more familiar with the European style of the umbrellas with a stick attached to them, though they look very similar to a mushroom. However, Babington made it very clear the burial monument resemble a "native umbrella" i.e., an umbrella made of palm leaves without a handle which the earlier people of Malabar used by keeping it on their head (Darsana 2007). John (1982) argued that *Koodakal* could be the original term for *Kodakkal. Koodom* refers to a roof presumably over the dead in the form of an *ola kuda*-palm leaf umbrella. Based on the linguistic use of the term *'Kodakku Kottukuka'*- offering to the *Koda* (which means gift in Malayalam) in the places where the umbrella stones are found, he stated that *Kodakkal* could mean "ancestral stone to which offerings are performed" (John 1982: 148). Thampi had termed the *kudakkal* as umbrella stone with handle and *Topikkal* as umbrella stones without handle (John 1983), as both types of umbrellas are in vogue in Kerala.

As there is terminological confusion about the *kudakkal* and *topikkal,* we can call the mushroom shaped burials as mushroom shaped umbrella stones and the hat stones without the clinostats as bun-shaped hat stones and that may reduce the confusion to a certain extent (Darsana 2007). Significantly, the hat stones are concentrated in the midland zone, while the umbrella stones are noticed in the highland regions.

Type 3

a. Cists (*muniyara*)

This box like structure made of orthostats of granite slabs is found buried in the ground. Sometimes, they are made of huge blocks of stone with an average of 60 cm thickness, 120 cm wide and 270 cm long (Gurukkal and Varier 1999). It is interesting to note that nearly 84% of sites of cist burials is found with other burial types and only 16% is seen as single sites. Cists are reported in all the places of Kerala, including the high-land zone of Kasaragode where a solitary cist burial site is noticed.

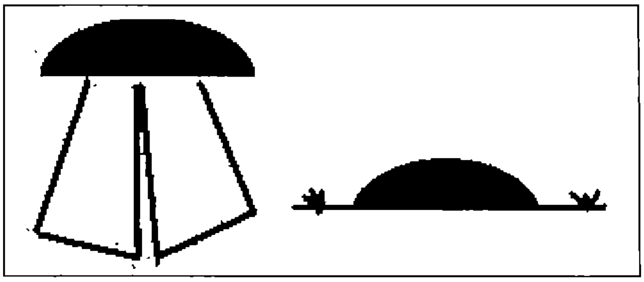

Fig. 5: *Kudakkal* and *Topikkal* (Photo)

b. Rock Cut Caves (*Muniyara*)

In the laterite zone, where laterite can be cut and worked easily, one finds a number of rock cut caves (RCC), and they are unique to Kerala (Fig 6, see cover page 2). More than one hundred rock cut caves are found in the region, especially in the northern part of Kerala, distributed mainly from Kasaragode in the north to Thrissur in the south. They are on highlands, while a few are in the midlands. They are cut into the laterite with one or many cells and they have a top opening usually covered with capstones and steps leading to the entrance. Some are found with pillars and benches. Most chambers are single and at few places, multi-chambered caves are noticed, as at Kattakampal in Thrissur. Mostly, the rock cut caves yielded grave goods such as iron objects, and varieties of pottery. Interestingly, a few of the burials in the Kasaragode region yielded Neolithic pottery, indicating the survival of the residual elements of the Neolithic culture in the Iron Age-Early Historic period (Jayashree 2007). Nearly 81% of RCC are single sites and 19% occur with other types.

Analysis of Burial Assemblages

The grave goods that are interred in the burials provide information regarding the people and their culture. In the present analysis, grave goods from all 46 excavated burials are analysed. The important assemblages include iron weapons, iron implements, pottery, and semi-precious beads, and at few places, copper, gold and bronze objects. A few terracotta objects are also found in the burials. It is pertinent to note that due to the absence of complete skeletal remains from the burials, it becomes difficult to analyse the physical anthropological aspects of the skeletons. In all the burials, only fragments of bone are found. However, the data on bone remains is also presented. No floral evidence is forthcoming. It is to be noted in some burials, due to the lack of information given in the reports, it is not clear whether the grave goods are absent or not recorded. The absence of data on grave goods is a serious handicap in the analysis of burials. However, this was overcome by using all available data to present a coherent picture on the Kerala megaliths.

Iron Objects

Iron objects, as important grave goods of the megalithic culture, are found in many burials. However, so far no attempt has been made to classify them according to types and utility, except Leshnik (1974), who contributed to a typology of iron objects from south Indian megaliths. As far as Kerala is concerned iron objects are divided into two main types - weapons and implements. Despite the fact that iron is the most important grave good, only a few studies on it have been done. The metallic hook from Pazhayannur was tested and it was found that it was made of thin iron sheets and beaten into shape. The purity of the iron is estimated to be 99.62%, while the impurities were a mere 0.38%. The study also revealed the folding and forging technique that was used by megalithic populations indicating a superior knowledge in metallurgy (George and Mehta 1978). Metal objects from Naduvil, Atholi and Manaothody were studied at National Research Laboratory, Lucknow (IAR 1990-91: 163). However, results of these analyses are not known.

Iron Weapons

Regarding weapons, common types include axe, dagger, arrowhead, spearhead, knife and trident (Fig. 7). The axe can be used both as a weapon and as a cutting tool for various purposes including agriculture. The axe is the only weapon noticed from the only excavated menhir site of Marayur. It is found at five sites (3 urns, 1 menhir and 1 *topikkal*). Daggers and knives are used as defensive weapons. The dagger has a wider distribution as it is noticed in all types of burials except menhirs and *topikkals*. It is noticed at ten sites. Knives are also found at 10 sites and the maximum occurrence is from RCC. Here from four burials, we have evidence for knives with varieties of tanged specimens. Arrow heads and spear heads are essentially weapons of war and hunting. Arrowheads are noticed predominantly in hood stone burial, where it is reported in three burials. Spear heads are found in dolmen, *topikkal*, hood stone, and RCC. Spears are found more in RCC, i.e., in four burials. Sword, an important weapon, finds place in seven burial sites. It is found only in four types of burials namely cist, dolmen, *topikkal* and RCC and not found in other types. Trident which is found only in the Type 2 burials, namely, the umbrella stone, *topikkal* and hood stone, is a weapon as well as religious symbol sacred to the followers of Hinduism today. It might have been used as a weapon in all probability. It's significance in the burial needs to be studied further (Table 7).

With regard to the chronology of iron weapons in the Kerala megaliths, no definite evidence is available. Based on typology, Leshnik (1974) attributed the initial dates for each type of weapon in the archaeological context- axes to 250 BCE, arrowheads to 500 BCE, knife to 1st century CE, spear heads to 300 BCE, swords to 1st century BCE and tridents to 100 BCE. However, this cannot be directly applied in Kerala, as there is an ambiguous pattern emerging from the distribution of iron weapons, it is very difficult to assign dates to these types.

Iron Implements

As regards iron implements, the main types consist of chisels, sickles, tripod stands, bill hooks, nails and rods (Fig. 8). The only excavated example of a

Table 7: Occurrence of iron weapons in burials

Weapons	**Burial Type**
Arrowhead	Urn, *Topikkal*, Hood Stone
Axe	Urn, *Topikkal*, Menhir
Dagger	Urn, Dolmen, Hood Stone, Umbrella Stone, Cist, RCC
Knife	Urn, Hood Stone, RCC
Spear heads	Dolmen, *Topikkal*, Hood Stone, RCC
Swords	Dolmen, *Topikkal*, Cist, RCC
Trident	Umbrella Stone, *Topikkal*, Hood Stone
Miscellaneous	Urn, RCC

menhir in Kerala, did not yield any iron implement except for a solitary axe. The chisel is a tool of an artisan. It is widely prevalent as it is found at 11 burial sites. It occurs in almost all types except in *Topikkals,* hood stones and menhirs, showing its popularity and importance given to it by the megalithic people in the world of living and the dead. It is also found in many burial types. The tripod stand is unique and is used for supporting a pot. It is found in three of the hood stones dug at Cheramangad. The sickle is a multipurpose tool and can be used effectively in pastoral and agricultural activities. It is also a widely prevalent tool as it occurs in many types of burials. The presence of sickles and bill-hooks does indicate that primitive agriculture coupled with pastoralism was the subsistence pattern of the megalithic population. At Panunda, an iron bar was found which is compared with an effigy that symbolizes the dead man (Raghavan and Devasahayam, 1974). A ploughshare was reported from Arippa and two wedges from Mangadu and Kunnukara, probably used for splitting the wood or rock (Table 8).

From the above information, we come to know of the existence and use of various types of iron weapons and implements, such as swords, knives, dagger, spearheads, sickles, bill-hooks ploughshares, and arrowheads in the megaliths of Kerala. Though these tools indicate hunting/gathering combined with pastoralism (Gurukkal and Varier 1999), the presence of agricultural tools does point to the existence of agriculture and horticulture in the region, perhaps to a limited extent. Moreover, the reference to blacksmiths *(Kollars)* specialized in iron making in Sangam texts (*Akam* 202, 224) indicates the presence of iron smelting as one of the main crafts of the ancient Tamil country.

Other Metal Objects

Apart from iron, the burials yielded a few objects made of copper, bronze and gold. However, the data is limited as only 10 sites have yielded these metal objects (cists-4; Hoodstone-3; RCC-2 and Umbrella stone-1). In the pre-independence period, chemical analysis of bronze objects found at the cist burial of Tiruvilvamala was carried out by S.Parameswaran of the Madras Museum. This showed that the content of copper is 86.78%, tin 12.34% antimony 0.49%, and iron 0.36% (Govinda Menon 1937)

X-ray fluorescence analysis was done on copper and gold objects from Arippa (Rajendran and Badam 1995, Rajendran and Iyer 1997). The quality of gold was found to be very pure and gold objects show a high quality of technology through which they made very thin gold sheets measuring as little as 0.0075 mm.

Beads

Beads provided an important datum line for the burials. Out of the 37 excavated sites, only 11 (6 urns, 2 from cist, 1 from *Topikkal,* 2 from RCC) yielded evidence for the existence of beads. The cist burial at Machad provided 147 beads, the urn burial at Kurumaserry yielded nearly 136 beads, and 48 beads were found at the urn site of Porkalam and

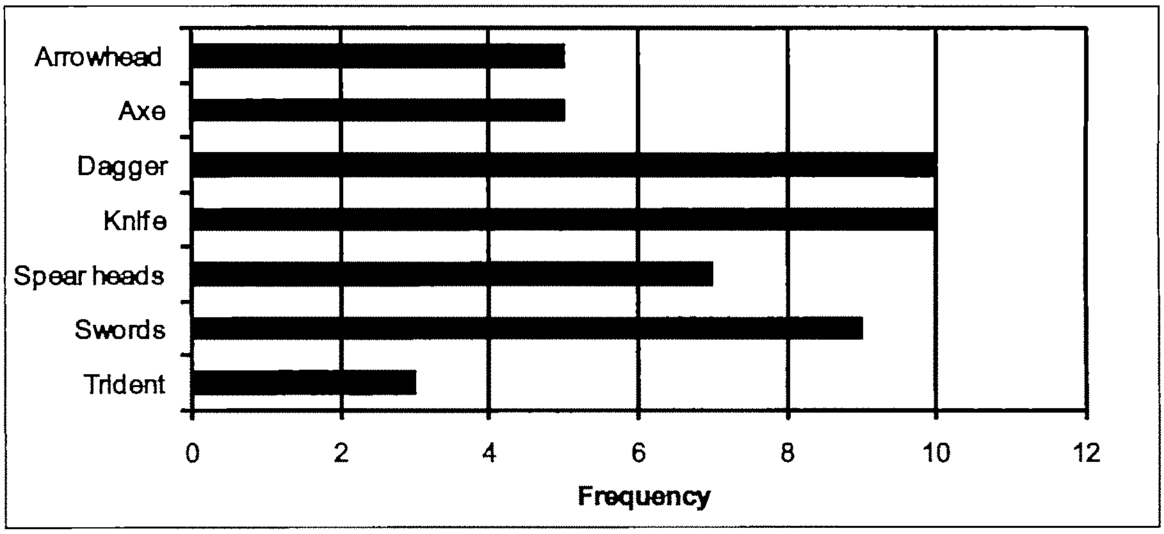

Fig. 7: Distribution of Iron weapons in Kerala megalith burials

Table 8. Occurrence of Iron Implements in burials

Implements	Burial type
Bill Hook	*Topikkal*, Cist, RCC
Chisel	Urns, Dolmens, Umbrella Stones, Cist, RCC
Nails	Cist, RCC
Rods	Urns, Cist, Umbrella Stone, Hood Stone, RCC
Sickle	Urns, *Topikkal*, Hood Stone, Cist, RCC
Tripod Stand	Umbrella Stones, Hood Stone, RCC
Wedges	Urns
Miscellaneous	Urns

at Mangadu, 30 beads were collected. They are not found in other types. Either they are absent or the data presented in the reports is too meager to know of the occurrence of beads.

Carnelian beads occupy a prominent place, as a greater number of carnelian beads including the etched variety is found. Thapar (1952) used the occurrence of carnelian beads at Porkalam and dated burials based on similarity with other regions. Carnelian is not locally available and hence it is believed that it must have come from outside, perhaps Gujarat, indicating cross cultural interactions among communities. Exploration is required to search for sources of carnelian in the borders of Kerala adjacent to Karnataka. There are more than 200 carnelian beads occurring in megalithic burials of Kerala. Apart from carnelian, beads made of jasper, glass, feldspar, agate, crystal, terracotta and quartz are also noticed in burials. However, a comprehensive study of beads is lacking.

Pottery

Common types of pottery associated with megaliths and found in almost all burials, include Black ware, Red ware, Black-and-Red ware and russet coated and painted ware. The main shapes include shallow, deep bowls, miniature pots, dishes, vases, legged jars and stemmed cup. Only two burials are completely devoid of any pottery, namely, a hood stone at Cheramangad (IAR 1990-91), and an urn burial at Machad (Mehta and George 1978). It is interesting to note the presence of Neolithic pottery types in the megaliths of Kerala at Umichipoyil indicating remnants of the preceding culture (Nair 2007). The RCPW dated between 1st century CE and 4th century CE is found in 7 burial sites (Chattaparamba, Anakkara 2, Punnol, Panuanda, Ummichipoyil, Cherumangad, and Tiruvilvamala) which help in dating the burials to the Early Historic period. As the ceramic evidence from burials is very sporadic, it is difficult to attempt a pottery typology from the existing sources.

Bone Remains

Only 19 sites have yielded human bone remains. Except menhirs, all other types of burials have bone remains (Fig. 9). However, they are too fragmentary to warrant a detailed study. Arippa is said to have yielded a child's cranium without teeth. The nature of soil along with the mode of burial seems to have played a vital role in the preservation of bones. It could be that the megalithic people indulged in secondary burial practices, wherein only select bones were collected after exposing the body to elements and interred in the burials. No complete human skeleton is found so far from any burial. This perhaps suggests the practice of cremation.

Discussion

Is there a pattern in burial types across the landscape, and burial goods based on availability of raw material, subsistence patterns or social organisation? Can one arrive at the social organisation or subsistence patterns of the megalithic people based on the analysis of the excavated burials or based on the distribution of burials across the landscape? Did the megalith builders play a role in the evolution of early historic society which established trade links with other countries? What was the status of the megalith practitioners in the society? Was there any contact with contemporary people? What kind of relationship did they have with others? These are some of the questions that guided the author.

Elsewhere in the world, grave goods have been analysed in detail to gather information about social organisation, economic conditions and subsistence patterns (Peebles and Kus 1977, Orton and Hodson 1981). In India, based on the analysis of grave goods of South Indian megaliths, Moorti (1994) tried to provide evidence for social organisation and subsistence patterns. In the analysis of Kerala megaliths, Moorti has taken evidence from Machad only, as data from many excavated sites remains

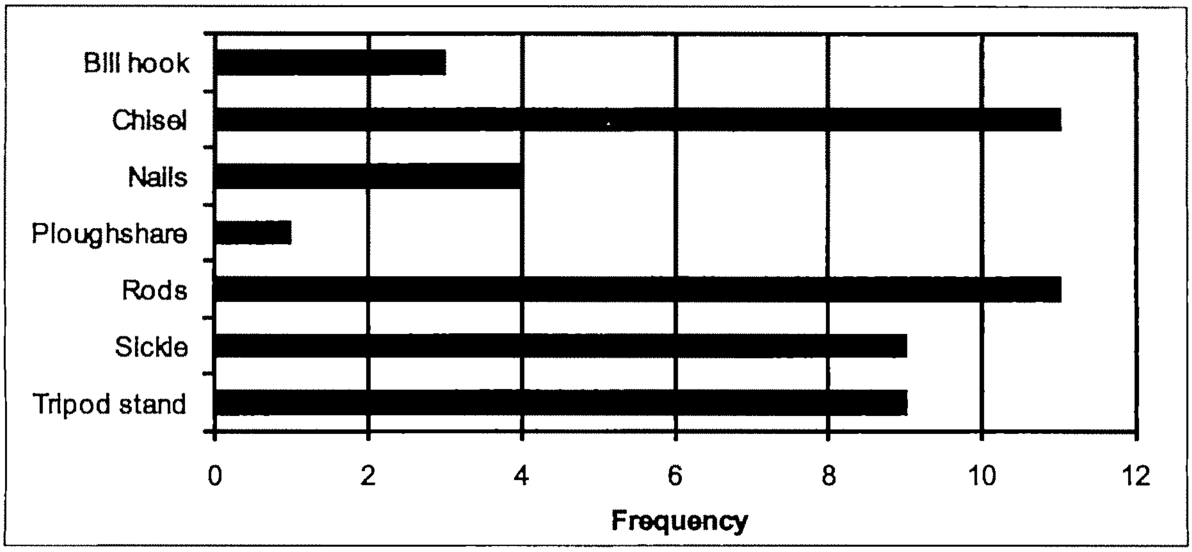

Fig. 8: Distribution of Iron Implements in Kerala megaliths

very sparse. In the Upper Palar basin, the author tried to analyse social organisation using textual and archaeological sources from landscape perspectives (Darsana 1998, and in press). Brubaker (2009) on the study on megalith monuments in Krishna-Tungabhadra Valley argues for clear social status distinctions as known from the "the sheer typological diversity of the monuments".

Though many scholars have attempted to identify the subsistence pattern and social organisation of the megalithic people of Kerala (Gurukkal 1987, 1989, 2010 Gurukkal and Varier 1999), most interpretations are based on textual analysis of Sangam literature. An attempt has been made here to use archaeological data in sync with the text and arrive at new interpretations

It is pertinent to note that Moorti (1994), who did pioneering work in understanding the social organisation of the megalithic culture of South India, used data from only one excavated site of Kerala, namely, Machad, excavated by Mehta and George (1978). For various categories, the information remains blank, when compared to sites in Andhra, Karnataka, Tamil Nadu and Vidarbha. However, in this paper, an analysis of all available burial remains from all excavated burial sites of Kerala starting from Chattaparamaba (Babington 1823) to Umichipoyil (2007) has been conducted to arrive at interpretations on subsistence patterns and social organisation.

The prevalence of many types of burials in Kerala prompted a few historians and archaeologists to come up with different interpretations (Gurukkal, 1989, 1996; Gurukkal and Varier 1999). The varied types of burials and different kinds of grave goods indicating a hierarchy based on social or economic authority, point to the respect shown to dead ancestors. Many complexities are involved in the final product of megalithism. To quote, "it is not death, life after death, hero worship and ancestral cult alone that the megaliths represent. They embody cultural differences within one and the same life-world" (Gurukkal and Varier 1999:148).

To understand the life of megalithic people of the Iron Age-Early Historic period, we have at our disposal contemporary literary texts known as Sangam literature. Apart from the *Puram* songs compiled by many bards in praise of kings and chieftains, *akam* songs celebrate the concept of love and inner feelings. The environmental background for all actions is classified into a five-fold landscape also known as *tinai*, namely *Kurinji* (Hilly zone), *Mullai* (pastoral zone), *Marutam* (riverine zone), *Neytal* (coastal zone) and *Paalai* (arid zone). Each landscape has its own subsistence system governed by environmental conditions conducive for an occupation. This includes hunting and gathering in *Kurinji*, animal husbandry in *Mullai*, agriculture in *Marutam*, fishing in *Neytal* and robbery in the *Paalai* zone. As far as Kerala is concerned, it has been observed that the lowland i.e. the coastal sandy loam zone is suitable for paddy and coconut cultivation, the loamy, gravely midland is suitable for pepper and ginger production and the highland for forest produce such as cardamom and cinnamon (Chedambath 1997:

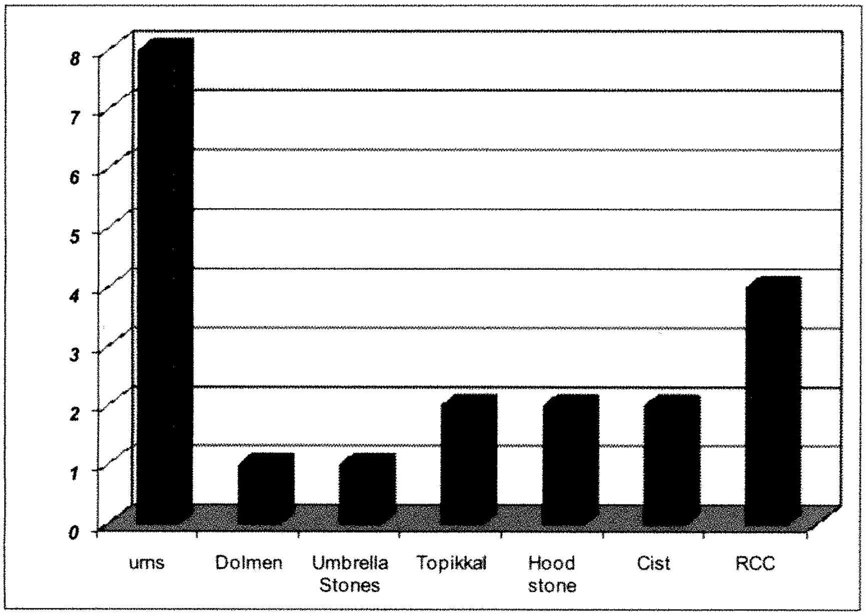

Fig. 9: Distribution of bones from burials

265-266). The entire stretch of coastal land with backwaters is used for fishing.

Thus the ecozones offered various resources for people, and whatever was not locally available were obtained through exchange. The literary texts provide numerous references to the movement of people of the five zones to one another in search of livelihood. Barter system is one of the modes of exchange. Travel for subsistence may not be the only reason, but various factors such as marriages, adventure, and career could have guided the movement of people.

Local resources were converted into finished products. Literature refers to various crafts that were prevalent in the later part of the BCE and in the early part of CE. Potters, blacksmiths, gold smiths and bead-makers are referred to in a few poems. A few Tamil Brahmi inscriptions also mention craftsmen (Selvakumar and Darsana 2008; Gurukkal 2010). The occurrence of iron objects, beads, and others in the grave assemblage indicates probably a megalithic society that utilized the services of various crafts-people for consumption in this world, as well as in the nether world.

Social Stratification

Building an urn is a common method for disposing the dead. Sometimes, they occur without any lithic appendages mainly in the lowland in which rock necessary for building megalithic burials is lacking. Wherever possible, in the midland and highland, the same urns are buried in the earth with elaborate lithic appendages above. This does not necessarily mean that all people who lived near the coast resorted to burying the dead in urn burials, as most urns are found in the lowland and a few in the midland regions. Similarly, due to the large scale occurrence of urns, one cannot claim that they represent common people, although Logan (1887: 181) stated that "meaner individuals had to be content with the less pretentious tombs, and accordingly it is found that in many localities in the district massive half baked sepulchral urns, simply buried in the grouped together ... in large numbers".

Although Sangam texts refer to the making of huge urns for kings *(Puram* 228:10-15), these urns may not reflect the real social standings of a person. However, urn burials could be expanded in post-cremation processes, involving building stone appendages such as *kudakkal*, *topikkal*, or interring them in rock cut caves. They do reflect the social standing of a person. The internment of rich objects such as gold could be also taken as an indication of higher social status. It can be argued that apart from the subsistence of the groups concerned, other factors such as social complexity, economic criteria, and political motivation could have guided people to select a suitable burial type for the group. Some groups might have preferred a specific mode of burial for their dead ancestors.

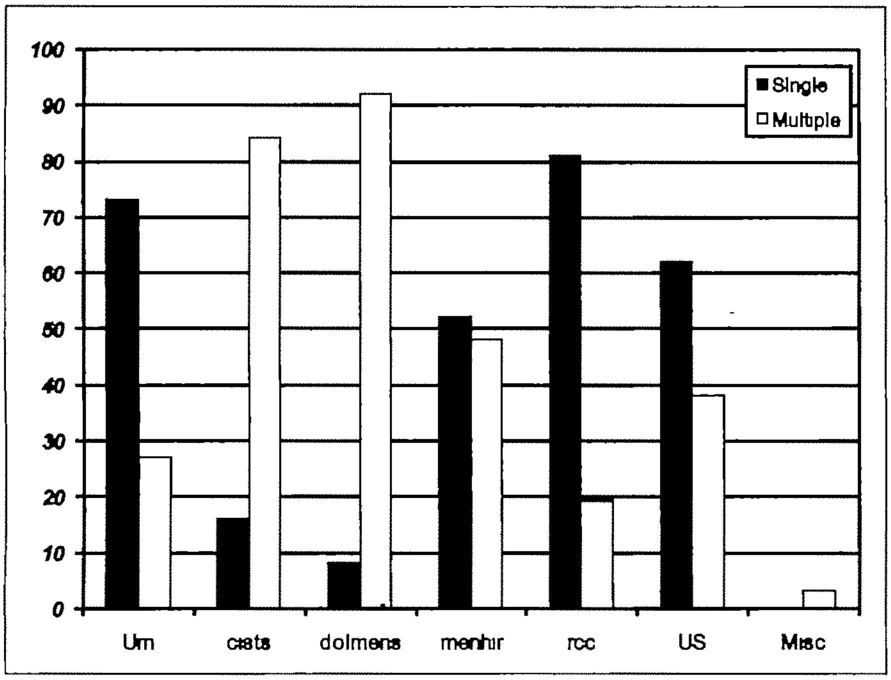

Fig. 10: Distribution of single burial sites and multiple burial sites

Rock cut caves could have also been carved as cultural markers to differentiate cultural land areas from the natural world, in this case, the rocky infertile land (*vanpulam*) from agricultural lands (*menpulam*). The occurrence of a few burials seems to indicate that the rock cut caves were probably constructed for the few privileged ones, may be the *Gothra thalaivan*[3]– the head of the clan, as indicated by the fact that more than 80% of RCC sites are single sites. A few of the RCC are found with elaborate entrances thus attesting to the fact that certain sections of the people in society were given a special position. Thus as against marking natural boundaries, there might have arisen a need to mark cultural identity and this could have prompted the elaborate construction of rock cut caves for those who were important in the social structure. More research is needed to test this hypothesis.

Amalgamation of various groups of burials is noticed at select sites, where we have the presence of more than one burial as evidenced at Porkalam, and Cherumangad. Perhaps, these places played a crucial role in the life of megalithic population (Fig. 10).

Dating the burials also remains a vexed problem for researchers. Except for a handful of sites, no scientific dates are available for the majority of the burials. It becomes difficult to date each type when there is little information. At some places, urns are older and in some, later (e.g., Mangadu and Porkalam). Hence assigning the same chronology for the same type of burial based on one date is a problem. The RCCs are considered later, while the dates for cists, dolmens are not clear. Wherever the RCPW occurs, one can date the burials to the Early Historic period.

Due to the very nature of the terrain of Kerala, natural and cultural formation processes played a vital role in the preservation of archaeological sites (Gurukkal and Varier 1999). Because of their sacredness, the megalithic burial sites made of durable stones have withstood the vagaries of time and nature. However, the habitation sites associated with the burials are conspicuous by their absence, except for the solitary example of Pattanam. Even Pattanam has more evidence for the Early Historic as compared with megalithic habitation materials on the surface. Only this excavation has brought to light scanty megalithic habitation layers. The climate of Kerala, high population density, and of course lack of intensive and problem oriented surface surveys, have contributed to the absence of habitation sites.

Despite the differences in regions and types, similar types of grave assemblages from various burial types point to the fact that megalithism was not a localised phenomenon but generic. In order to know all aspects of megalithism as practiced in

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[3] Comment made by local villagers in Kerala

Kerala, the need of the hour is for systematic surveys for habitation sites and scientific excavation of select burial sites, with an interdisciplinary perspective and publication of data. This would help in getting a clearer picture of the megalithic culture of Kerala.

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Book Reviews

Archaeology in India Individuals, Ideas and Institutions

Gautam Sengupta and Kaushik Gangopadhyay (Eds).
2009. Munshiram Monoharlal Pvt. New Delhi

There are several books, dealing with different aspects on archaeology of India which have been recently published. The constant effort of organizing an annual national seminar on very essential and less talked about subjects of Indian archaeology by the Center for Archaeological Training and Studies Eastern India (CASTEI), Kolkata is really remarkable. It is hearting to see that CASTEI is bringing out monographs every year on seminars they conduct on different themes. This volume entitled "Archaeology in India Individuals, Ideas and Institutions" is also the outcome of the National Seminar held during November 2005 at CASTEI, Kolkata. The volume incorporates twenty articles basically oriented towards the theme (History of Archaeology in India- Ideas, Institutions and Individuals) having a greater emphasis on different processes adopted by individuals and institutions who were pioneers in their fields of research, and who developed methodologies and influenced the growth of Indian Archaeology. Though this book contains twenty articles, the broader aspect and underlining outlook, brings together diverse achievements sometimes spanning a period of 100-150 years, in the history of archaeological research in India. The influence, dedication and direction of scholars are well represented in some of the core articles. The papers have been organized in five sections keeping in mind their basic focus area and content. A general observation of the book reveals that the topics cover the achievements of a few antiquarians and a few scholars/ individuals in pursuit of the past, responsible for archaeological investigation through the ages, and their contribution is seen in recent developments in archaeological research.

The review and critical observations on the growth of Archaeological Survey of India by M.C. Joshi gives a clear picture of the contribution of this organisation through time. It reveals the kind of atmosphere and ups and downs the officials faced from inception to recent times. His memories and his observations narrated in this article definitely serve as a beacon of light, inspiring and guiding archaeologists of the present era to retain ethics, discipline and perseverance required for the subject, as exemplified by some of illustrious archaeologists of bygone eras. The essence of his thought has revolved around the sense of guardianship which enthused officials to look into Indian culture and to inspire them.

The subsequent section has four articles devoted to achievements of scholars who initiated investigations into our past during the antiquarian phase, and who contributed immensely in recognizing cultural diversity found in different contexts across the country. The article by K. Paddayya is on Colonel Mackenzie, a British surveyor official and an antiquarian of veracity. His enthusiasm and perseverance was responsible for several discoveries beginning with Neolithic ash mounds at Kudatini and Budigunta in Bellary District 1801-1802. His findings later opened a new field of investigation culminating in understanding various settlements of the Neolithic phase in South India. John Babington's discovery of the Panducoolies of Malabar coast published in 1823 is considered to be the earliest account of South Indian Megaliths. However, a scrutiny of documents by Mackenzie suggests that he may be the first person who initiated, recognized and recoded these megalithic monuments prior to Babington, and who often took suggestions from him. He is credited for his famous discovery of the Amaravati Stupa in Guntur District, Andhra Pradesh, and for indirect investigations at the Sanchi Stupa. His investigation of monuments at Sanchi was instrumental in involving Lieutenant Edward Fell who not only documented them, but also published the first account of the Great Stupa at Sanchi. They were remarkable achievements in portraying the excellent monumental Buddhist architecture in south and central India. As mentioned by Paddayya "Mackenzie's role in facilitation of the discovery of Sanchi serves to re-emphasized his deep and wide-ranging interests in the investigation of antiquarian remains of the country" and it is fully justified looking at his achievements. It is gratifying to observe, besides their primary job, the kind of ingenuity seen in their pursuit for knowledge into unknown facets of Indian archaeology. Mackenzie's investigation not only speaks of his achievements but reveals the contribution of a number of persons, the "unsung heroes" who contributed in various ways. This kind of observation on lesser known amateur archaeologists or antiquarians has provided an impetus for further investigation into our cultural past. The historiography of the work of these amateurs will certainly inspire contemporary archaeologists.

Bishnupriya Basak gives a vivid assessment on Valentine Ball's contribution to Indian Archaeology especially the discovery of prehistoric archaeology and rude stone monuments now known as Megaliths, in the northeastern part of the country. Ball's contribution has been highlighted from his documentation of various ethnic groups and their life ways in Central India. His contribution, vision and ideas remain to inspire archaeologist of different eras.

Sir Alexander Cunningham and his contribution to Indian archaeology have been spoken of by various scholars. However, Upinder Singh has brought out several unknown or lesser known facets of Cunningham's personality, his research methodology and preferred areas of investigation. Cunningham's long association with Indian archaeology both as an antiquarian and later as Director General, his discoveries and publications speak about Being in the helm of affairs for a long time, exploring and excavating across the country and his bias for historical archaeology has been praised by many and criticized by a few. His long association with India, its culture and people, is reflected in his writing and discoveries. His publications of voluminous excavation reports and memoirs remain to be emulated. Singh has viewed both his tenure and work and has placed his achievements in perspective.

Indian archaeology sans Sankalia is difficult to comprehend. He was an institution by himself. Atre's observations of Sankalia based on his correspondence brings out new dimensions of his personality. His pursuit for archaeology had no boundary. His openness, objectivity, curiosity and compassion are well brought out. She has brought out some unexplored qualities of Prof. Sankalia.

The section on 'Ideas' has three essays devoted to object-specific historiographic research. Suchandra Ghosh's article on Indo Bactrian and Indo Greek coins deals with gradual development of numismatic studies by various scholars in developing various approaches in understanding socio-economic, cultural, technological, administrative and religious aspects. Her article is a good example of how systematic, methodical, numismatic studies of a particular dynasty can throw light on various aspects of the rulers of the dynasty, chronology/ period, culture and the region of activity. The other two articles on ceramic studies in India (by B.C. Deotare *et al.* and K. Gangopadhyay) bring out approaches towards analysis, interpretation and relevance of ceramics in any archaeological context. Ceramic studies have grown over the years and are an inseparable aspect in understanding Indian archaeological remains from Neolithic-Chalcolithic to the recent past. Both the articles will be quite useful for students of ceramic studies.

The content under 'Institutions' has been judiciously organized under three subdivisions. They include 'Modern Indian States' and under 'Princely States', and contribution by some important 'Institutions'. The first section deals with the History of Archaeology in Kerala, History of Archaeological Research in Tamil Nadu and History of Archaeology in Bihar by S. Darsana, K. Rajan and Bijoy K. Choudhary, respectively. Their observations and approaches brings out some lesser known archaeological records, evidence and research carried out pertaining to a wide chronological horizon starting from Prehistory to Medieval periods. In general, all these three articles describe important studies starting from 1800 -1900 A.D. to recent times. They will certainly be beneficial to students pursuing regional archaeology in respective areas in modelling their future research courses. The second sub-section entitled 'Princely States' relates to some of the enlightened princely states who patronized heritage studies. The article on archaeology under Baroda state by V.S. Sonawane, Mayurbhanj state, Orissa by R. Mukapadhay and in the Nizam State by K.P. Rao, unfold the nature of patronage, and discuss renowned academics and personalities of the period. In a country where rich influential educated people have often least interest in supporting preservation and conservation of heritage, it is hearting to see how these princely states encouraged heritage studies by appointing eminent scholars of their period and providing sufficient funding.

The section on 'Institutes' reviews some important organizations like the Asutosh Museum at Kolkata, Kamrup Anushandan Shamiti in Assam and Kolkata University. The contribution of these institutions in initiating, encouraging and fostering archaeological research is laudable.

The last section on Indian architecture and other issues do not quite fit the theme of the book but are well documented. P.P. Dhar and Rajat Ray's articles deal with different aspects of architecture, and conservation and provide an excellent review on progress made in those fields. V. Selvakumar's article on Arikamedu is a critical assessment of the site, its place in Indian archaeology, the potential it has, and the way the site has been interpreted by archaeologists over the years. It brings out various aspects relating to changing perceptions of an important archaeological site investigated and excavated by several agencies involving several scholars for a long period of time.

The credit for bringing out this book and earnestly editing it goes beyond doubt to both editors. There are a few minor oversights, here and there, which are human and often unavoidable. The book is an excellent addition to the growing demand of books on historigraphical research. It will inspire generations of archaeologist in structuring research strategies based on earlier observations and findings.

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Makers and Shapers

Shereen Ratnagar
2007. New Delhi: Tulika Books. Price Rs. 625.00

The book is a mini compendium of elementary technologies that went into building civilizations since ancient times. It is a worthy outcome of the survey Shereen Ratnagar conducted in order to correlate ancient products and technologies that go into production of similar products in a contemporary setting. This is also reflected in the subtitle of the book 'Early Indian Technology in the Home, Village and Urban Workshop'.

Shereen Ratnagar has taken into account various products found in archaeological excavations covering the pre-Indus culture period till the Mauryan period through the stages of OCP, PGW and NBP ware. Indian civilization underwent definite changes in archaeological settings as marked by these distinct phases on the way to emerge into the historical period. There is a clear discontinuity observed between the Indus Culture and the following cultures as the PGW and NBP. These are marked by distinctive pottery, and different firing techniques adopted to achieve their distinguishable glazes.

There are separate chapters devoted to each type of technological product. Chapter 2; 'The Technological foundations of the Food Producing Village', brings out the difference between a sedentary village and ancient settlements of moving populations. Shereen Ratnagar points out that teams of hunter-gatherers were formed largely on a voluntary basis, whereas in agricultural villages the work group was, what she terms 'familial'. Sedentary groups were 'tied to land' and they helped one another out during labour bottlenecks (p. 15). Civilizations underwent transformations from the hoe to plough cultivation to improve food production, thereby changing subsistence levels. As far back as 7000 B.C. in the earliest farming and animal raising village at Mehergarh, twelve types of wild animal bones were identified. It confirms the importance of hunting as a supplementary activity. Early society also learnt about secondary diet sources (forest products), such as *mahua* flowers and seeds for food ingredients (p. 16). These were also used for making wine (which is not mentioned in the book).

Other chapters are related to production techniques of pottery (Chapter 3), house construction (Chapter 4), water supply and sanitation (Chapter 5), metallurgy of non-ferrous metals (Chapter 6), ivory carving and shell cutting (Chapter 7), wheeled transport (Chapter 8) and working with stone (Chapter 9). There is a long chapter devoted only to the production of iron and steel (Chapter 10) and a small chapter on the interdependence of glass processing technology with iron processing technology (Chapter 11).

The author studied archeological sites and simultaneously surveyed current buildings and the fabrication techniques prevalent in these areas. As she mentions, her interactions with artisans from Gujarat on various techniques currently used by them were most illuminating. She also came across castes and sub-castes of familial and professional groups, that have continued production traditions for generations. As her fieldwork continued, this study turned into a study of village craft traditions.

Reading this book was extremely interesting, as the author describes various aspects of production techniques such as firing pottery kilns, metal furnaces and casting metallic objects including non-ferrous castings. Different sections of village artisans apply different techniques which they have followed as part of their family traditions. As it emerged, the production of various items needed joint efforts by groups of people. They found it necessary to remain united. This they achieved by way of forging family ties resulting in the formation of castes and sub-castes. This happened in both India and Sri Lanka. The similar trend of family ties among metal workers, specially iron and steel producing groups is found in African countries. Terry S. Childs reported "... that men fabricated a blood brotherhood in order to work together. Group feelings reinforced the 'Kinship' (Childs 1999)." (p. 169). This is very similar to '*Roti-beti vyavahār*' practiced in the Indian setting.

Shereen Ratnagar provides interesting observations and writes "In the orthodox Marxist approach with its focus on tools, especially the tools of forest for the village has unfortunately too often been overlooked". (p. 16). At other places, she states that broken tile pieces have received little attention, so that an important link on reuse of tiles is missing. Baked tiles were often preserved and reused in ancient times as is done even today. She observes a significant correlation here, i.e. rectangular houses correlate with sedentary life (p. 75) and discusses 'whether it was iron tools that made feasible the large-scale use of bone arrowheads points and needles' (p. 199).

The author describes various production techniques such as smelting of iron ores by different groups and the pyro-techniques used by them to achieve higher temperatures for reducing atmosphere in the smelting furnace (p. 156). Some of these are not easily available in contemporary books on metallurgy for young archaeologists to refer. This book will help young archaeologists appreciate efforts and technological nuances that are helpful to conduct in situ observations. There are more than hundred and twenty photographs and figures together at the end of the book. These help in understanding details of production techniques described. Technical details given in the book and pictures of artisans and their products point to the great efforts put in by the author to collect authentic information. This book is in fact a very good reference source for young archaeologists before they start using the spade at excavation sites.

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Recent Research Trends in South Asian Archaeology: Proceedings of the Professor H.D. Sankalia Birth Centenary Seminar (10-12 December 2007)

K. Paddayya, P.P. Joglekar, Kishor K. Basa and Reshma Sawant (Eds.)
2009. Pune: Deccan College Post-Graduate and Research Institute, pp. 432. Price Rs. 700/-

The present volume is the outcome of an international seminar organised on the occasion of the Birth Centenary of Prof. H.D.Sankalia, and which is now published in the form of a proceedings volume. The opening pages in the volume are by Prof. B.B.Lal who delivered the inaugural address during the seminar. His address is divided into three parts – reminiscences of Sankalia, Aryan invasion/ immigration theories, and some random thoughts on certain aspects of Indian archaeology. Professor B.B.Lal in his address has rightly describes Prof. Sankalia "an eternal flame that lighted hundreds of other flames".

This volume has five sections under different thematic heads. Section - I is dedicated to Prof. H.D. Sankalia in which a galaxy of scholars express their memories. This section begins with an exhaustive personal profile of Prof. Sankalia accompanied by photographs from the days when Sankalia was a student participant in the excavations at Maiden Castle in England in 1936. The first article in this section is by Dr. K. Paddayya and is entitled 'Homage to the Sankalias'. This is a tribute by Paddayya in which he remembers both Smt. Sarlaben Sankalia and Prof. H.D. Sankalia. In addition to describing the last moments of Prof. Sankalia, Paddayya delineates the seminal contributions of Sankalia for the cause of Indian archaeology, and his attitude and views towards the discipline. Further, Paddayya also visualises the present day scenario of archaeology in the country in the light of Sankalia's philosophy. The lesser known dimensions of Sankalia's life, i.e. his attitude towards socially backward classes and economically weaker sections of the society and his perception of religion and God are also discussed. Following this article is a long chapter on 'Reminiscences of Prof. H.D.Sankalia' mostly by his students, friends and scholars. These include Rahman Ali, G.L. Badam, Subrato Chakrabarti, R.D. Choudhary, Barun De, M.K. Dhavalikar, Shobhana Gokhale, A.P. Jamkhedkar, Vidula Jayaswal, M.D. Kajale, V.S. Lele, Malti Nagar, M.S. Mate, V.D. Misra, V.N. Misra, G.C. Mohapatra, M.S. Nagaraja Rao, K.P. Nautiyal, K. Paddayya, J.N. Pal, Suman Pandya, R.S. Pappu, N.S. Phadke, G.P. Pradhan, S.N. Rajaguru, Ravindra Sankalia, V.H. Sonawane, A.S. Sundara, Suraj Bhan, K. Timma Reddy, D.N. Tripathi and Radha Kant Varma. These reminiscences on Prof. H.D.Sankalia are an addition to what we read earlier published in the special volume of Man & Environment, Vol. 14 following his demise.

Section II contains eight contributions in prehistory. The first article in this section by S.N. Rajaguru, S. Pappu, S. Deo and Sheila Mishra summarizes recent research on various Lower Palaeolithic sites that are carried out by the authors in the last decade. The sites that have been discussed in this paper includes Didwana in Rajasthan where new information has emerged from recent studies, Madhuban in Gujarat where site is associated with miliolites, Morgaon in Maharashtra where sites are associated with tephra, and Attirampakkam in Tamil Nadu where recent excavations have yielded new information on the context and age of Palaeolithic sites in Peninsular India. The second article in this section by G.C. Mohapatra reviews the various dimensions of lithic age in the Siwaliks of Punjab, to which he has substantially contributed. In fact Mohapatra has reviewed his own understanding on the Stone Age of the area in this article. The third article by V.N. Misra enumerates the evolution of society and culture from Lower Palaeolithic to Early Historic period through the local manifestation of Chalcolithic culture in the form of Ganeshwar-Jodhpura culture in Rajasthan. This cultural development as delineated by Misra from Stone Age Hunter-Gatherers to the emergence of agriculture-based life, emergence of urban life, and finally culminates with the introduction of iron technology and the beginning of Historical Period is based on economic criteria. Misra summarizes salient aspects of ethnographic data in order to provide an idea on cultural continuity in the area. The fourth article by Sheila Mishra *et al.* is on researches in the Acheulian based on recent excavations carried out at Morgaon in district Pune, Maharashtra. Chronologically the site at Morgaon has been placed in the Early Acheulian phase and the detailed result of these investigations is described. The fifth article by K. Thimma Reddy reviews Stone Age archaeology up to Neolithic cultural phase of the Eastern Ghats and the surrounding areas of Andhra Pradesh. The sixth article by Suman Pandya and M.V. Desai deals with archaeological evidence from the Mesolithic to the beginnings of agriculture along with ethnographic analogy from Dhansura Pradesh which is part of the present Sabarkantha district of Gujarat. Data pertaining to archaeology comes from both small scale excavations and explorations in the area. The next article in the prehistory section is by J.N. Pal, which summarizes research into the archaeology of the Ganga Plain and the Vindhyas as revealed from recent excavations. The last article in this section by K. Paddayya deals with the contributions of the father of Indian Prehistory Robert Bruce Foote to Indian Prehistory. Besides other publications on Foote, Paddayya provides some additional information about Foote's contribution to prehistory that he researched in Cambridge University Library and Oriental and India Office Collections of the British Library in 2004. The portion that deals with background to Foote's discoveries in India is quite interesting as it describes the beginning of prehistoric research. Besides, Paddayya also describes how Foote's discoveries impacted in other parts of the world.

Section III 'Protohistory' contains ten articles. The first one in the series is by M.K. Dhavalikar that deals with Cemetery H culture. In this article Dhavalikar tries to understand the Harappan mind from paintings depicted on the pottery of Cemetery H. The second article by Gregory L. Possehl includes his thoughts and memories of H.D. Sankalia. It would have been more appropriate to include this article in the first section entitled 'Remembering Professor H.D. Sankalia'. Suraj Bhan in his review article on Protohistoric Haryana has given a comprehensive account of cultural succession in Haryana between 3000 BC and 400 BC. Now it is known that there are nearly 1800 protohistoric sites which have been located in Haryana. The continuous broad cultural succession in Haryana as described by Bhan includes Sothi-Siswal formation, Harappan formation, Post-

Harappan formation, Painted Grey Ware culture formation and finally Northern Black Polished Ware formation. I personally do not understand why the author calls these cultural phases as "formation". The fourth article in this series is by K.P. Nautiyal and R.C. Bhatt who discuss how the archaeology of Central Himalayas (Uttarakhand) has been influenced by cultural contacts with Central Asia and Tibet during the 2nd-1st millennia BC. The discovery of the site of Malari about 61 km northwest of Joshimath, is significant with evidence of burials. These burials have yielded human skeletal remains, skeletal remains of a zoba, spouted pot, pedestalled cup-type pot with handle and other pots, iron objects, golden masks, etc., establish significant cultural connection between western Tibet and India. The fifth article by V.D. Misra and Pragya Misra describes salient features of the Neolithic culture of north-central India (Vindhyan area). About two dozen Neolithic sites have been explored in the area, of which excavations have been carried out at six sites:–Koldihwa, Mahagara and Pachoh in Belan valley, Indari and Tokwa in Adwa valley and Kunjhun in Son valley. As they describe, the Neolithic culture of north-central India is characterized by sedentary settlements, cultivation, and domestication, rounded variety of polished axes, microlithic components and hand-made pottery. The sixth article in this section by Vibha Tripathi summarizes the archaeology of Ganga plain in the light of recent discoveries. Besides giving an account of the geographical-ecological background of Gangetic plain, she discusses issues such as the beginnings of agriculture, cultural evolution through a Neolithic–Chalcolithic continuum, copper-hoards and the interface between Harappan and the OCP, beginning of iron technology and finally the chronological framework and cultural dynamics of the Ganga plain. This article is appended with exhaustive list of radiocarbon dates from Vindhya-Kaimur Area and Ganga plain. The next article is by P.C. Venkatasubbaiah that gives an account of recent archaeological investigations in the Kuppam region of Chittoor district, Andhra Pradesh. This area has yielded the evidence of megalithic burial sites, memorial or hero stones and medieval temples, and sculptures. As regards the Neolithic Cultural remains is concerned, as yet no concrete evidence has come to light except three stray polished axes recovered from village Kodagallu. The eighth article in the section by Nicole Boivin et. al. is titled "Re-examining Rock Art studies in India: A case study from Kurnool district, Andhra Pradesh". In the first section the authors describes problems related to chronology, documentation, systematic and quantitative studies, and studies of contemporary rock art production in Indian rock art research. The discussion on this by the authors provides one with an impression that nothing has been done in India as regards rock art research is concerned. In fact this clearly shows that authors are not abreast with recent research carried out and literature published in rock art studies in India. The rock art sites discussed in this article lies in three separate valleys; the Jurreru river valley, Katavani Kunta valley and Yaganti valley in Kurnool district. The ninth article by Carla M. Sinopoli is on recent excavations of an Iron Age site at Kadebakele located on the northern bank of Tungabhadra River, district Koppal in Karnataka. This excavation forms part of a larger collaborative project entitled "Late Prehistoric and Early Historic Landscapes of the Tungabhadra Corridor Project" between Karnataka Directorate of Archaeology and Museums, University of Chicago and University of Michigan. This article is appended with exhaustive charts of radiocarbon dates, ceramic ware frequencies and faunal frequencies from Kadebakele excavations. The last article in protohistory section is by M.L.K. Murty entitled "Cultural Identities and Realm of the past: A Regional Perspective of the Southern Deccan". In this article Murty theorizes that "... in the course of post–Mesolithic socio-cultural developments (Neo-Chalcolithic, Iron Age, Pre-Satavahana and Satavahana) in southern Deccan, human social groups with hunting-gathering cultural systems have not been obliterated, but negotiated both in physical and cultural space in a trajectory of mutualism, interactive exchange and power relations with historical cultures." He also states, "... from the Neolithic-Chalcolithic times, the habitats experienced transformations in the social and political milieu giving rise to nucleated villages, fortified townships, military leadership and centres of provincial authority; and the economic systems were oriented to new modes of production, craft specialisation and distributive mechanism of commodities through market networks". Murty's interpretation is based on the archaeological evidences that come from the area. He considers the area as environmentally homogeneous and contiguous and believes that various archaeological occupations across various micro-regions of the Southern Deccan points out that they come under the category of "areas of attraction" as proposed by B. Subbarao.

Section IV is devoted to 'Historical Archaeology' and has eight articles. The first article in this section is by Shobhana Gokhale who tries to understand Buddhist architecture and inscriptions of Nasik Caves in Maharashtra against the backdrop of Buddhist literature. The synchronism between inscriptional evidence, architecture and Buddhist literary traditions is so good in case of Cave No. 3 at Nasik that Gokhale describes it as 'Triveni Sangama in the history of Buddhist architecture in western India'. The second article by Vidula Jayaswal focusses on the study of non-urban sites through archaeological investigations, and is based on more than a decade of research, in the context of Varanasi as an urban centre. This is an interesting paper and a unique study in which the chronological and spatial growth of ancient Varanasi, along with its satellite settlement is examined in a chrono-cultural perspective. The third article by P.J. Cherian, V. Selvakumar and K.P. Shajan is the result from the recent excavations carried out in 2007 at Pattanam in Ernakulam district of Kerala. This site has yielded evidence including a dugout canoe that throws light in understanding the maritime traditions of the Malabar Coast. The fourth article in the series is by Shahnaj Husne Jahan who enumerates archaeological investigations that have been carried out in recent years in Bangladesh. The fifth article by Rahman Ali is a short review of the studies that have been mostly carried out by the author himself in the past on art and architecture of Central India particularly of the Gurjara-Pratiharas, Kalachuris, Paramaras, Dasarnadesa (East Malwa) and Kachchhapaghatas. The next article is by K. Mankodi on the Ranki Vav at Patan in Gujarat. He critically discusses some of the interesting images in this step well. This would certainly add to the existing knowledge on this one of the most ornate and largest example of step well in the country that is being proposed to inscribe in World Heritage list. The seventh article is by G.B. Deglurkar who writes on iconography of Narasimha by tracing its origin as described in literature and in the sculptural compositions found in Marathwada and Vidarbha region. The last article entitled 'Medieval Deccan – An Historical Perspective' is by M.S. Mate who discusses Deccani Sultanates of the medieval period. In fact Mate discusses two aspects of these sultanates in a historical perspective. The first aspect is on the origin of the Deccani Sultanates and the second aspect is on they managed to rule for three and a half centuries, over a people who were different and alien to them.

Section V contains eight articles of a miscellaneous category. The first article by Prayag Raj Sharma describes how Dr. H.D. Sankalia's indirect contribution helped in understanding the archaeology of Nepal. The second one is by Kenneth A.R. Kennedy who describes Prof. Sankalia's contributions in understanding modern palaeoanthropology. Kennedy highlights on the riddle of two different monographs on Langhnaj Excavations bearing the same date of publication and super-titles and with some repetitions of contributions by different authors which he describes as 'mystery'. The third article in this series is by Shubhangana Atre which is based on the study of archival records of 165 files spanning over forty years since 1939, the year of inception of the Department of Archaeology at the Deccan College. Based on some of the correspondence of Prof Sankalia, Atre tries to focus on certain aspects of Sankalia's profile. She highlights how Prof. Sankalia was keen on interpreting how the present could be related to the past. Besides, Dr. Sankalia's concern for adopting a multidisciplinary approach in archaeology and in taking archaeological research to the realm of common man is beautifully reflected in his correspondence with Prof. Saha at the Indian Science Congress, Kolkata (Calcutta) in 1969 wherein he writes "It has been one of my aims all these years that we should be able to communicate our research, however important and technical it might be, not only to the scholars in our disciplines but sister disciplines as well as to the layman". The fourth article by M.D. Kajale is a comprehensive review of archaeo-botanical studies that have been carried out by Deccan College in India and Sri Lanka. The next contribution in this section is by D.P. Agrawal *et al.* in which some of the indigenous knowledge system and practices of Uttarakhand have been considered to interpret the archaeological evidences. The sixth article is by V. Selvakumar that studies the ethno-history, ethnographic and ethno-archaeology of Paliyans, a community in the Varushanad-Andipatti hills in Tamil Nadu. The seventh article of Shereen Ratnagar that is based on some of ethnographic observations of potters and pottery production proposes re-examination of ceramics from archaeological sites that have been classified earlier as handmade and wheel-made. The last contribution in this section is by Kishor K. Basa which gives a detail account of various museum exhibitions and intangible cultural activities of Indira Gandhi Rashtriya Manav Sangrahalaya (IGRMS), Bhopal – the largest anthropological museum of the country.

The only drawback in this volume is the quality of archival photographs and the drawings. Otherwise this voluminous book is certainly a tribute to Prof. H.D. Sankalia and a significant addition to the understanding of various dimensions of Indian archaeology.

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The Shahir-I Sokhta Graveyard (Sistan, Iran), Excavation Campaigns 1972-1978

Marcello Piperno and Sanra Salvatori,
2007. Rome: IsIAO.

This is an excavation report on the skeletal remains found at the site of Shahir-I Sokhta in Iran which was excavated from 1972 to 1978. The necropolis is dated around 3rd millennium B.C. This book gives significant information on the burial practices of the period. It is a comprehensive documentation of the skeletal remains and grave goods. The monograph is divided into three parts with an appendix.

The first part deals with a general introduction to the site, formulation of the problem and planning of the excavation over such a vast area. The first discovery of the site was in the year of 1972 under the Italian archaeological mission directed by Prof. Maurizio Tosi. This was followed by a series of excavations extending till 1978.

The later part of the same unit deals with methods used for excavations and the recording of the findings from this necropolis "... in which diggers should be able to work their way backward in time… ". Systematic sampling was conducted. Even samples were collected from inside vessels. The numbering of the graves was done progressively. Different types of graves were encountered, including simple rectangular pits and burial chambers of various shapes.

The second part of the report deals with various types of postures seen in the grave pits. Extensive charts document the position of the skull and limbs. General information is provided on the utilization of space within the pit, grave orientation, etc.

The third part, which comprises the major body of the report discusses varied aspects of the graves in great depth. A photograph and line drawings of each grave is provided. Information on the age, sex, grave type, number of individuals, depth of the burial, etc. are presented. The information on grave goods is meticulous and includes details on types of pottery and associated antiquities like stamp seals, bronze double-sided head pin, beads, etc. This shows the richness of the graves. In some burials there is evidence of the use of textiles.

It is interesting to note that skeletal age estimation and the determination were done on-site itself. Various age brackets (foetus to middle aged adults) were identified. Both males and females are represented in the burial ground. There are certain burials where more than 6 to 7 individuals were buried together. In grave no. 1003 twelve individuals were buried in a circular brick tomb. Amongst them was a skeleton of a one year old child. Three males and three females were buried together in grave no. 311, all of whom were middle aged adults. In some graves females were buried with a child or children, e.g. in grave no. 719 a female and a 7-8 year old child were buried together; grave no. 743 has one adult female with two children aged between 5 and 8 years. In one case (grave no. 743) a foetus was buried in the pit.

At the end of the report an appendix on decorative motifs on pottery with drawings.

This book provides interesting evidence on burials in the necropolis of the 3rd millennium B.C. The excavators have done their job of recording evidence with utmost care. It should be admired that maximum information is provided in a systematic manner for each grave.

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Conference Report

The 11th International Conference of Archaeozoology (ICAZ) at Paris, 23rd- 28th August 2010

Every four years the ICAZ (International Council of Archaeozology) organizes a conference in different countries, the last one being in 2006 at Mexico. The ICAZ comprises members from all over the world with a common interest in the archaeology of ancient animals. Today, it is further divided into many groups and subgroups classified as working groups which keep the organization active. These include working groups such as those dealing with fish, archaeozoology and genetics, neotropical zooarchaeology, taphonomy, worked bone, ASWA and more recent archaeomalacology, etc.

The conference at Paris was co-organised by Jean D. Vigne, Mary Patou-Mathis and Christine Lefevre. The venue was the Jussieu campus in the UPMC very close to the Museum national d'Histoire naturelle and the botanical gardens Jardin des Plantes. The opening session was held at the Amphitheatre Farabeuf (Cordeliers, 21 rue del'Ecole de Medicine) in honour of the Late Prof. A. T Clason, an eminent archeozoologist from the Netherlands and one of the oldest member of the ICAZ. On the evening of 24th August a welcome reception was organized for all the delegates in the central hall of the Grande Galerie de Evolution. Holding the conference in Paris was one of the key reasons for the good turnover of delegates from different parts of the world. More than 400 delegates from countries such as USA, Canada, UK, Ireland, Germany, Netherlands, Denmark, Spain, Russia, France, Italy, Belgium, Israel, Lebanon, Abu Dhabi, Egypt, India, Philippines, Korea and China were present.

All academic sessions were held at various amphitheatres in the Jussieu Campus. Around 31 parallel sessions were held. Both oral and poster presentations were made. These covered diverse ranging topics such as archaeozoology of Holocene Africa, circumpolar archaeozoology: arctic hunter-gatherers in context, old world camelids, island faunal translocations, cervids and society: deer in time and space, raw and worked osseous materials, new perspectives in taphonomy, hominin subsistence in the old world during the Pleistocene and early Holocene, climate change, human response and zooarchaeozoology, archaeomalacology, contribution of archaeozoology in the study of human societies in South, Southeast and East Asia from the palaeolithic to the pre-modern era. It was in this latter session that only two Indians were able to physically participate. Limited attendance of Indian delegates sadly draws attention to the scarce representation of south Asia in a global context.

Some sessions such as the geometric morphometry in zooarchaeology, application and perspectives, archaeozoology in the digital world, biogeochemical study of animal remains: integrating isotopic and trace elements analysis to zooarchaeology, archaeozoology and palaeogenetics: potentials and limits were of special interest. These helped acquaint delegates with the use of latest scientific techniques in the analysis of faunal material. A general session was orgainsed for presenting assorted topics which did not fit with the sessions or which were included at last minute. More importance was given to posters with fewer oral presentations. This gave all delegates a good opportunity to interact rather than being confined to the lecture rooms.

On 28th August the conference drew to a close on an informal note with a general meeting of the ICAZ, where a review of the entire conference was made through a PowerPoint presentation. This was followed by poster prizes given to student participants. A special word of praise should be extended to the conference orgainsers for their excellent organization which began in August 2009. Their hard work showed in the smooth running of the conference. Time management and good planning was what that made the ICAZ conference at Paris a big success. For me it was an enriching experience and an excellent opportunity to interact with fellow archaeozoologist working in diverse regions as far as the arctic and wide ranging issues dealing with ancient faunas. The next ICAZ will be held at Argentina in 2014.

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Conference Report

Report on the conference *Les premiers peuplements prehistoriques sur les differents continents*, Paris, 2-6th June, 2010, Institut de Paléontologie Humaine

An international seminar entitled "*Les premiers peuplements prehistoriques sur les differents continents*" was organized by Professor Henry de Lumely at the Institut de Paléontologie Humaine, Paris, from 2-6th June, 2010. This formed a part of the centenary celebrations of the Institute and was inaugurated by the Prince of Monaco, His Highness Albert II. Invited scholars from France, Italy, U.K, Belgium, Spain, Turkey Ethiopia, Senegal, Algeria, Cameron, South Africa, Korea, China, Japan, Indonesia, India, Russia, Georgia, Australia and the USA, presented papers on a range of topics on prehistory. Translation facilities (English-French and vice-versa), were provided on two days; a facility which was of immense use for all delegates.

More than 65 papers were presented. ranging from the taxonomy and phyletic evolution in early *Australopithecus* to the Pleistocene colonization of America. Some papers of interest from the Indian perspective included the work on palaeontological evidence and archaeological assemblages from the site of Gona, Ethiopia, discussing the emergence of stone tools at 2.6 Ma. Of great interest for Indian prehistorians, was the paper on Konso and Middle Awash sites dealing with the evolution of the Acheulian, beginning around 1.7 Ma to 0.8 Ma. New discoveries from Turkana and sites in North and South Africa, provided an excellent overview of the Palaeolithic record in this region. Other important evidence from sites in Europe such as that of Dmanisi, Georgia, and sites in China, Korea and Japan, provided an overview of cultures ranging from the Lower to the Upper Palaeolithic across the world.

Only four Indian scholars were invited for this conference. Manoj Kumar Singh spoke on the possibility of finding human fossils in India. Kumar Akhilesh spoke on the Acheulian assemblages of Northern Tamil Nadu, in terms of their chronology, technology and transitions to the Middle Palaeolithic, and discussed applications of both field studies and satellite remote sensing data for the same. Shanti Pappu discussed recent results of technological studies of Acheulian assemblages at Attirampakkam, in relation to other Acheulian sites in Tamil Nadu. Sheila Mishra discussed the hypothesis that India was one of the original homelands for mankind. Olivier Notter discussed the results of his recent studies at the Acheulian site of Chirki-on-Pravara, while Amélie Vialet discussed recent results of studies of the hominin cranium from Hathnora.

Sessions began sharply at 9 am and would end at 6 pm with breaks for coffee in addition to lunch, during which delegates could continue discussions. It was meticulously organized with ample time for scholars to present their papers. On the last day of the conference delegates were taken for a trip to view Paris by air, from a giant balloon; an exciting experience. Personally, it was a great opportunity for me to participate and interact with scholars working in different parts of the world, in particular to observe the passion with which the subject of prehistory is pursued in other parts of the world.

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Report of the General Secretary for 2009-2010

(01-04-2009 to 31-03-2010)

As in previous years, functioning of the Society for the year ending on 31-3-2010 has been satisfactory, both academically and financially. Regular activities of the Society were carried out successfully. We are grateful to the Indian Council of Historical Research (ICHR) and the Archaeological Survey of India (ASI) for financial support for publication of the Society's Journal *Man and Environment* as well as in organizing the annual conference. The audited statement of accounts for the period ending 31-3-2010 is printed in this Volume (XXXV No. 2).

Man and Environment

This is the thirty-fifth year of the publication of the Journal and twenty-third year of its biannual publication. The journal continues to attract a wide range of manuscripts by scholars from within and outside the country. The circulation of the Journal is slowly, but steadily increasing. The editors are constantly trying to enhance its quality.

Depending on the content of the contribution all the articles are sent to referees for comments and suggestions. In 2009-2010 following scholars were approached with a request to act as referees: Prof. M.K. Dhavalikar, Dr. K. Ismail, Dr. Alok Kumar Kanungo, Dr. Madhavi Kolhatkar, Dr. Anupama Kshirsagar, Prof. K. Krishnan, Prof. Sheila Mishra, Dr. R.K. Mohanty, Prof. K. Paddayya, Prof. J.N. Pal, Prof. S.N. Rajaguru, Prof. K. Rajan, Dr. Gwen Robbins, Prof. V.S. Shinde, Dr. R.N. Singh, Prof. V.H. Sonawane, Dr. Chanchala Srivastava, Dr. Rakesh Tewari and Prof. D.N. Tripathi. The Society thanks all these scholars for sparing their valuable time.

We sincerely thank Mr. Sujit Patwardhan and his staff of Mudra Press, Pune for their excellent cooperation in the production of the Journal.

New Life Members

The following persons joined the family of life members of the Society during 2009-2010: J. Ahmed, Gautam Bondada, Sandeep Kumar Chaudhari, D.K. Chauhan, A.D. Gedam, O.C. Handa, S. Padigar, Nidhi Pandey, Siddharth Shankar Rai, Vijendra Rai, Neetesh Saxena, Nirmala Shukla, Sanju Shukla, Anupama Singh, Pushpalata Singh Deepshikha Srivastava, Jalaj Kumar J.K. Tiwari, Sachin Kumar Tiwary, Abha Tripathi, Vithakan and Surendra Kumar Yadav

Minutes of the Meetings of the Executive Committee

(1) The first meeting of the Executive Committee of the Society in the year 2009-2010 was held on the 25th September 2009 at 9.30 am. P.K. Thomas presided over the meeting. Following members were present: V.N. Misra, P.K. Thomas, P.P. Joglekar, Shanti Pappu, S.G. Deo, Arati Deshpande-Mukherjee and Arun Sinha.

Item No. 1 was about recommendation of the names of office bearers (for the term of 2010-2013) to the General Body. Dr. Thomas suggested the following names of office bearers for the term 2010-2013 and the Committee unanimously accepted the list.

Chairman	Dr. P.K. Thomas
Vice Chairman	Shri S.B. Ota
General Secretary	Dr. P.P. Joglekar
Joint Secretary	Dr. Shanti Pappu
Assistant Secretary	Dr. Reshma Sawant
Treasurer	Dr. Sushama Deo
Editor	Prof. V.N. Misra
Joint Editor	Dr. P.P. Joglekar
Joint Editor	Dr. Shanti Pappu
Associate Editor	Shri Arun Sinha

Item No. 2 was about recommendation of the names members of the executive committee (for the term of 2010-2013) to the General Body. The Committee unanimously decided to recommend following names: Bala Subrannaniyan, Suman Pandya, Chanchala Srivastav, P.B.S. Sengar, Jeevan Kharakwal, Arati Deshpande-Mukherjee, S.K. Aruni, Prabhakar Upadhyay, Bishnupriya Basak, Sheekant Pradhan and R.K. Mohanty.

After discussion over the matter selecting the President for the year 2010-11, the Committee decided to select Dr. Rakesh Tewari as the President for the year 2010-11. After discussion, it was decided that Prof. K. Paddayya will deliver Prof. H.D. Sankalia Memorial Lecture in 2010. For the R.K. Sharma Award 2009, the Committee selected Prof. D.P. Agrawal.

The committee was informed by Dr. P.P. Joglekar that due to increase cost of production the price of the journal should be revised. After discussion over this matter, committee decided to revise the price of journal from existing Rs. 600/- to Rs. 800/- from June 2010.

Prof. V.N. Misra suggested Shri Arun Sinha's name to join the editorial board of the Journal as an Associate Editor. In this regard the committee unanimously accepted Shri Sinha as an Associate Editor.

The meeting ended with a vote of thanks to the Chair proposed by Joint Secretary P.P. Joglekar.

(2) The second meeting of the Executive Committee of the Society was held at the Department of Ancient History, Culture & Archaeology, University of Allahabad on 15th November 2009. The following members were present:

P.K. Thomas, P.P. Joglekar, Arati Deshpande-Mukherjee, S.G. Deo, K. Ismail, Anup Mishra, Shanti Pappu. Binodini Devi and V.H. Sonawane.

Dr. P.K. Thomas, General Secretary presided over the meeting. He welcomed the members and appraised the Committee on major activities of the Society during 2008-2009. The discussion that followed was related to the annual conference of the Society in the previous year at Bhubaneswar and publication of Vol. XXXIV (1) of *Man and Environment*. He also apprised the Committee of the details of the audited statement of Society's income and expenditure during 2008-2009, which is printed in *Man and Environment* XXXIV (2). The report presented by the General Secretary and the audited statement of Society's income and expenditure during 2008-2009 were approved and recommended for presentation in the meeting of the General Body of the Society. The meeting ended with a vote of thanks to the Chair.

Annual Conference

The 37th Annual Conference was held, in conjunction with the 43rd Annual Conference of the Indian Archaeological Society and 33rd Annual Conference of the Indian History and Culture Society between 14th to 17th November, 2009 at Allhahabad. This conference was organized by the Department of Ancient History, Culture & Archaeology, University of Allahabad, Allahabad. Nearly 150 life members of the Society participated in the conference.

Inaugural Function

The inaugural function of the joint Annual Conference of the three Societies was held at 11:00 am, on 14th November, 2009. Dr. Rajan Harshe, the Vice-Chancellor of the University inaugurated the event. Prof. B.B. Lal, one of the senior most life member of the Society, graced the occasion as the chief guest of the function. Prof. G.K. Rai, the local organizing secretary welcomed all the delegates. Several research papers were presented during the sessions of the ISPQS.

Presidential Address

The Presidential Address of the Society was delivered by Professor Vidula Jaiswal of the Banaras Hindu University. The title of the address was 'Status of Archaeology of the Middle Ganga Valley: Stone and Early Iron Age Cultures' and it has been published in Volume XXXV (1).

Professor H. D. Sankalia Memorial Lecture

The Eighth Professor H.D. Sankalia Memorial Lecture was to be delivered by Prof. V.N. Misra, however, he could not attend the conference. The abstract of his lecture was circulated, and the full text would be published in the Journal.

The Academic Sessions

The academic sessions of the conference were held on the 15th, 16th and 17th November 2010 and the following papers were presented:

Kumar Akhilesh and Shanti Pappu: New Perspectives on the Lithic Technology and Chronology of Prehistoric Sites in Tamilnadu

Shanti Pappu: Recent Research on the life of Robert Bruce Foote

Pradeep K. Behera, P. Sinha and A. Nayak: Barpadar: A Late Acheulean Site in the Bargarh Upland, Orissa

Sheila Mishra: Rethinking of Periodization of Lower Palaeolithic

Giriraj Kumar: Lower Palaeolithic petroglyphs obtained from the excavations at Daraki-Chattan in India from 2002 to 2006

Vidwan Singh Soni and Anujot Singh Soni: Recent Discoveries in Indian Sub-Himalayas: Call for a re-interpretation of the Soanian

Dilbur Bhengra: Neolithic Culture of North-East India with special reference to Sikkim and Mizoram States

S.G. Deo, Savita Ghate and S.N. Rajaguru: Holocene Beach-Dune Complex Rock (Karal) in Coastal Maharashtra: Significance for understanding cultural Ecology

Rama Kant: Evidence of Subsistence pattern in the Mesolithic Culture of Vindhyas

Anup Ranjan Mishra: From Weapon to Epitome of Power: The Journey of Anthropomorph

J.N. Pal: Recent Researches on the Stone Age Cultures of the Middle Son Valley and Future Plan of Research

Tilok Thakuria, P.J. Cherian, R.K. Mohanty and V. Selvakumar: Craft, interactions and marketing assessment of stone beed manufacturing craft at Pattanam, Kerala, India

V.D. Mishra, J.N. Pal and M.C. Gupta: The Origin and Chronology of the Chalcolithic Culture of the Vindhyas and the Ganga Plain

C.V. Sharada and P.P. Joglekar: Faunal Remains from Madina, Rohtak, District- Haryana

Pankaj Goyal and P.P. Joglekar: Faunal Remains from Jaidak (Pithad), A Sorath Harappan site in Gujarat

Karuna Shankar Shukla: Decoding the Indus-Saraswati Script – A New Approach

Deepshikha Srivastava: Ecological conditions around the archaeological sites of Upper Ganga plain during Proto historic period - A study based on animal bones

K. Krishnan: Petrography of Ceramics from Bhirrana

P.P. Joglekar, P. Singh and A.K. Singh: Faunal Remains from Waina, Ballia district, Uttar Pradesh

Shitala Prasad Singh: Chalcolithic Cultures of the Purvi Uttar Pradesh: An Overview

Kantikumar Pawar: Discovery of an Iron smelting site of the Satvahana period in Solapur district of Maharashtra

D.P. Tewari : Further excavations at Sanchankot: 2008-09

Sunil Gupta, Ajay Kumar Mishra and Amol Kulkarni: Crisis on the Roads: Excavations at Bankat 2008

Tilok Thakuria: A Study of Bangles from Nevasa, Maharashtra

Tosabanta Padhan: Traditional Saura Art and Rock Art of Orissa, an Ethnoarchaeological Perspective

Arati Deshpande-Mukherjee: Medieval use of Oyster (*Crassostrea gryphgides*) and Chank (*Turbinella pyrum*) resources on the Indian West Coast: Evidence from Sanjan

Oishi Roy: Art during early Iran Age, Megalithic Culture of Peninsular India

Sujata Gautam and Yaswant Singh: Representation of Women in Rock Paintings of Central India

Ritu Jaiswal and P. Sinha: Burial Custom and Ethnic Group in Mesolithic India

Meeting of the General Body of the Society
The Annual General Body meeting of the Society for 2009 was held on the 15th of November, 2009 in the premises of the Department of Ancient History, Culture & Archaeology, University of Allahabad,

Allahabad at 4.40 pm. The meeting was presided over by Prof. V.D. Misra.

At the outset, the General Secretary, P.K. Thomas, welcomed the members and presented the report of the activities of the Society for the year 2008-2009. The members of the Society unanimously approved it. The General Secretary placed the Annual Audited Statement of the Accounts for the year 2008-2009 before the General Body, and the members present unanimously approved it. The General Secretary appraised the General Body of the decisions taken in the meetings of the Executive Committee of the Society in the current year. After discussion all the decisions of the Executive Committee were unanimously ratified. For the R.K. Sharma Award for 2009 was conferred upon one of the founder members of ISPQS, Prof. D.P. Agrawal.

Joint Secretary P.P. Joglekar proposed the name of Dr. Rakesh Tewari of the State Dept. of Archaeology, U.P. as President of the Society for the next year (2010). The proposal was unanimously accepted by the members present.

P.K. Thomas, General Secretary proposed the name of Professor K. Paddayya (Retd.), Department of Archaeology, Deccan College for the 20th Prof. H. D. Sankalia Memorial Lecture in 2010. The members present unanimously approved the proposal.

Elections to the posts of office bearers of the Society for the term of 2010-2013 were conducted. Prof. V.H. Sonawane acted as the presiding officer of the election. Following names of the members for various posts were suggested and were unanimously elected by the General Body:

Chairman	Dr. P.K. Thomas
Vice Chairman	Shri S.B. Ota
General Secretary	Dr. P.P. Joglekar
Joint Secretary	Dr. Shanti Pappu
Assistant Secretary	Dr. Reshma Sawant
Treasurer	Dr. Sushama Deo
Editor	Prof. V.N. Misra
Joint Editor	Dr. P.P. Joglekar
Joint Editor	Dr. Shanti Pappu
Associate Editor	Shri Arun Sinha

Based on the recommendation of the names to be elected on the executive committee (for the term of 2010-2013), the General Body unanimously elected following members:

Bala Subrannaniyan, Suman Pandya, Chanchala Srivastav, P.B.S. Sengar, Jeevan Kharakwal, Arati Deshpande-Mukherjee, S.K. Aruni, Prabhakar Upadhyay, Bishnupriya Basak, Sheekant Pradhan and R.K. Mohanty.

The President of the General Body meeting, Prof. V.D. Misra congratulated all the elected office bearers.

Dr. Shanti Pappu, Joint Editor of the Man and Environment proposed a vote of thanks for efficient organization of the conference, and General Body thanked Prof. G.K. Rai and his colleagues for excellent arrangements at Allahabad.

The meeting then ended with a vote of thanks to the Chair.

(P.P. Joglekar)
01-12-2010 General Secretary

THE BOMBAY PUBLIC TRUST ACT, 1950. - SCHEDULE IX (VIDE RULE 17 (1)
INDIAN SOCIETY FOR PREHISTORIC AND QUATERENARY STUDIES
C/O - DEPARTMENT OF ARCHAEOLOGY, DECCAN COLLEGE, PUNE - 411 006

BALANCE SHEET AS ON 31ST MARCH, 2010

Funds & Liabilities	**2008-2009**	**2009-2010**	**Property & Assets**	**2008-2009**	**2009-2010**
Trust Funds or Corpus			Immovable Properties		
Bal. as per prev.B/S.			- Computer Systems	8,370.83	3,348.92
Adjustment during the year	656,108.52	656,108.52	- Cupboards	6,933.60	6,240.24
(Donations recd. during the year)			- Dead Stock	719.10	611.23
(Created under the provisions of the trust deed			- An Purchase	183.60	156.06
income)			- Furniture & Fixture	11,737.90	10,564.11
			- Scanner	4,900.00	1,960.00
			Investments	2,327,964.18	2,430,394.33
Depreciation Fund			(As per Schedule II)		
Other Earmaked Funds	83,607.95	83,607.95			
Reserve Fund	1,839,163.51	1,835,182.16	Other Movable Properties		
Cash in Hand		0.00			
			Current Assets		
For Expenses			- Sundry Debtors	1,666.00	11,680.00
Other Deposits			Cash & Bank Balances		
Audit fee PROVISION FOR	8,440.00	3,720.00	Cash	750.77	523.77
Sundry Creditors		72,346.00	Bank Balances	224,882.97	185,485.97
Other Liabilities	788.94				
Income & Expenditure A/c.					
Bal. as per prev.B/S.					
Less : Appropriation if any					
Add : Surplus ofInc & Exp A/c		94,419.18			
Less : Trf to General Reserves	(98,400.53)	(94,419.18)			
TOTAL RS.	**2,588,108.92**	**2,650,964.63**	**TOTAL RS.**	**2,588,108.95**	**2,650,964.63**

As per our report of even date

For A G OGALE & ASSOCIATES Chartered Accountants	P. P. Joglekar General Secretary	Shanti Pappu Joint Secretary	S.G. Deo Treasurer

(A.S. CHANDVANKAR)
Partner

M No. : 043811.

Place : Pune
Date : 01-09-2010

THE BOMBAY PUBLIC TRUST ACT, 1950. - SCHEDULE IX (VIDE RULE 17 (1)
INDIAN SOCIETY FOR PREHISTORIC AND QUATERENARY STUDIES
C/O - DEPARTMENT OF ARCHAEOLOGY, DECCAN COLLEGE, PUNE - 411 006

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31.03.2010

REGN - GUJ - 508 - AHEMADABAD

Expenditure	**2009-2010**	**2008-2009**	**Income**	**2009-2010**	**2008-2009**
To Expenditure in respect of			By Rent (accrued)/(realized)		0.00
Repairs & Maintenance	0.00	0.00			
			By Interest (accrued)/ (realized)		
			On deposits (FD)	102,430.15	172,769.53
To Expenses on the object			On Bank Account	6,741.00	10,849.00
of the trust					
(as per schedule - A)			By Publication Grant - ICHR		60,000.00
Conference Expenses	60,266.00	84,071.00	By Publication Grant - ASI		60,000.00
Publication Expenses	340,322.00	205,876.00	By Seminar Grand Recd from ICHR	54,000.00	49,500.00
			By Secretarial Assistance Grants	500.00	
			By Excess Provisions Written Back	1,788.94	
Other Expenses	6,420.00	5,152.00			
			By Cost of monographs - DHP ETC		0.00
			By Life Membership Fees	96,700.00	10,000.00
To R.K. Sharma award	0.00	0.00	By Sale of M & E volume	150,831.00	47,270.00
To Depreciation	9,964.44	16,889.00	By Deficit carried over to B/s	3,981.35	
To Surplus carried over to B/s		98,400.53			
TOTAL RS.	**416,972.44**	**410,388.53**	**TOTAL RS.**	**416,972.44**	**410,388.53**

As per our report of even date

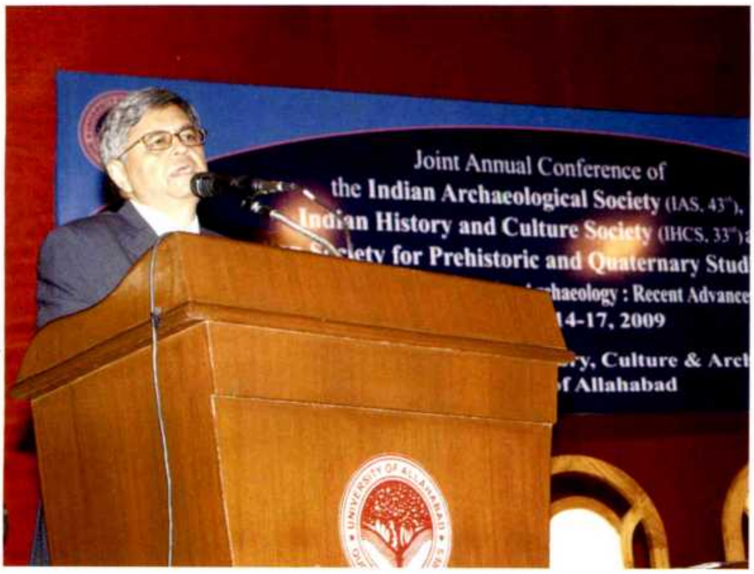
For A G OGALE & ASSOCIATES Chartered Accountants	P. P. Joglekar General Secretary	Shanti Pappu Joint Secretary	S.G. Deo Treasurer

(A.S. CHANDVANKAR)
Partner

M No. : 043811.

Place : Pune

Date : 01-09-2010


Joint Annual Conference of
the Indian Archaeological Society (IAS, 43rd),
Indian History and Culture Society (IHCS, 33rd)
Society for Prehistoric and Quaternary Stud
haeology : Recent Advance
14-17, 2009
ry, Culture & Arc
f Allahabad

Prof. G.K. Rai welcomed the delegates

Inaugration of the conference

Prof. Vidula Jayaswal delivered the Presidential Address

Volume XXXV, No. 2 (July-December 2010) ISSN: 0258-0446

Articles and Notes

1. **Systematic Transect Survey Enhances Investigations of Rock Art in its Landscape Setting: An Example from the Katavani Kunta Valley, Kurnool District, Andhra Pradesh**
James Blinkhorn, Janardhana Bora, Jinu Koshy, Ravi Korisettar, Nicole Boivin and Michael Petraglia 1

2. **Reconstructing Operational Sequences: A New Methodology for the Study of Seal Carving in the Indus Civilization**
Adam S. Green 15

3. **Further Research into Harappan Metrology at Dholavira**
Michel Danino 35

4. **Review of Archaeological Investigations in the Protohistoric and Historical Archaeology of Vidarbha**
Reshma Sawant 45

5. **A Note on Two Protohistoric Sites in Deodurga Taluk, District Raichur, Karnataka**
H. Chandrashekhar 66

6. **Geophysical Investigations of a Sand Deposit at Kelshi, Ratnagiri District, Maharashtra**
Ashok Marathe, R.S. Wadhwa and M.S.Chaudhari 70

7. **Updates on the Antiquity of Iron in South Asia**
Rakesh Tewari 81

8. **Megalithic Burials of Iron Age-Early Historic Kerala: An Overview**
S.B. Darsana 98

Book Reviews

9. **Archaeology in India Individuals, Ideas and Institutions**
R.K. Mohanty 118

10. **Makers and Shapers**
Pramod V. Pathak 120

11. **Recent Research Trends in South Asian Archaeology: Proceedings of the Professor H.D. Sankalia Birth Centenary Seminar (10-12 December 2007)**
S.B. Ota 121

12. **The Shahir-I Sokhta Graveyard (Sistan, Iran), Excavation Campaigns 1972-1978**
Veena Mushrif-Tripathy 125

13. **Conference Reports** 126

14. **Report of the General Secretary for 2009-2010** 128

15. **Report of the Auditor for 2009-2010** 132

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